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PLAIN FACTS ABOUT THE PANAMA CANAL.

By John F. Wallace. With an Editorial Introduction.

IN this latest and most significant contribution by Mr. Wallace to the solution of the Panama Canal problem, the author speaks plainly of conditions as he found them and of the difficulties he met. He concentrates here the essence of his year's experience as chief engineer, so far as it concerns the present all-important question of the best mode of building the Canal. In demonstrating his point he divides the whole situation into three simple elements:—the proved inefficiency of direct construction by the Government; the entire applicability and certain economy of the contract system; and the sufficiency of the studies already made, and the data already collected, to enable contractors to bid intelligently and closely, and to enable the Government to judge of the reasonableness of the bids submitted. To this he adds a very practical proposal for the handling of the collateral factor—the Panama Railroad—in case the whole work is turned over to one chief contractor.

Under the first head, Mr. Wallace shows accurately the ways in which red-tape and political administration operate to make efficiency and economy impossible, and brings out the vital point that the trouble is inherent in the Governmental system and could not be dispelled by any change of personnel. Under the second head, he shows the diametrically opposite policy adopted by large corporate contracting and constructing organizations, and the economies of time, effort, and money thus secured; and he cites (in support of the

suggestion of letting the whole project by contract), the most successful and satisfactory instance in the entire history of engineering work under the auspices of the United States. Under the third head, he takes up chiefly the matter of unit costs, and points out the value which the work done under his administration might have in enabling either bidders or letters of the contract to reach reliable conclusions on these essential elements of total price.

It is hardly necessary to point out, further, that taking together the studies of the French Company, those of the two Isthmian Canal Commissions appointed by the United States, and those carried forward by the first and second Commissions charged with the construction of the Canal, there is a body of exact knowledge concerning the Isthmus—its geology, climate, rainfall, and every element entering into the calculations of the cost of the Canal—such as seldom, if ever before, was obtainable by prospective bidders on a large project.

Mr. Wallace speaks from the standpoint of the man who is intimately familiar with the conduct of work of the first magnitude under the tried and proved methods of business, and who has also tested "to the breaking point" the methods of political administration in the same field. The double experience gives him unusual insight and authority. We commend his views to the careful attention of all who are interested—officially, politically, professionally, commercially, or patriotically—in the speedy and successful completion of the Panama Canal.—THE EDITORS.

IN the introductory article of the series upon the Panama Canal, which appeared in this Magazine last autumn, I sketched broadly the questions naturally presenting themselves to an unbiased student of the whole problem presented by the Isthmian Canal.

The logic of events has eliminated the necessity for consideration of several of the points then indicated. The completion of the Isthmian Canal by America's greatest nation is a foregone conclusion. The expenditure of some $70,000,000 on a Panama route has settled the question of the general location, and it is inadvisable to confuse the public mind in any way by suggesting even the possibility of abandoning the Panama project and turning to another. The technical examinations of the engineers under American control have also confirmed the advisability of adopting the general features of the French location, and only minor deviations can be made therefrom. The enginering investigations conducted under the second Walker Commission and under my general supervison have accumulated suffi-

cient data to show that all the engineering problems are easily within the range of solution and practical execution, and that the various plans that have been advanced by reputable engineers from time to time are possible of execution.

The first great problem now before the American people is the selection of a general plan; and the questions determining the adoption of a high or a sea-level "type" involve merely the factors of time and cost. The studies thus far made show that the sea-level canal will cost, approximately, from $50,000,000 to $100,000,000 more than a multiple-level and will require from three to five years more in execution—the variations between the maxima and minima of difference in comparative time and cost depending upon the details of the different plans considered. These figures, however, are based on the proposition that some method of administration and execution can be evolved that will permit the work to be conducted with the efficiency with which a large contractor could do the work, having ample funds and talent at his disposal, and being unhampered by restrictive governmental methods.

The second great problem demanding solution is that of the proper mode of administration and construction. To my mind, the effects upon time and cost which may be exerted by policies of administration and method are much more important than any influences on time and cost pertaining inherently to the plans themselves. To state the proposition perhaps more clearly:—it is my opinion that it will take longer, and cost more money, to construct a high-level canal on the 85-foot plan, under the present methods of Governmental control, than it will to construct a sea-level canal, provided the work is accomplished by modern efficient business methods.

While it may be difficult to demonstrate this to the general public by a detailed description of the trivial things that make up the aggregate retardant influences of the Governmental method, the experience of the nation in the constructive field surely furnishes sufficient examples to prove this proposition practically. A single filament of hemp, easily broken and pulled apart by a child, may appear insignificant; but a million thereof, bound and woven together, can be made into a cable which will restrain a gigantic steamship of 20,000 tons burden. What is ordinarily designated as "Government red tape" is simply system gone to seed; it is due to the persistent tendency of the personnel applying that system to give greater consideration to the form and the routine than to the accomplishment of the results the system was designed to maintain.

Of the factors which exercise the greatest deterrent influence in the accomplishment of satisfactory results under direct Governmental control the first is found in the laws governing the disbursement of public funds, aggravated by precedents of 100 years and the multiplicity of decisions which have been made from time to time on specific points as they have been presented for decision to the authorities controlling the Treasury Department. The fundamental principle in the disbursement of Government funds has been to throw around each transaction every possible safeguard to see that the funds are properly expended. This intention—excellent in itself—has been carried to such an extent that the utmost effort is apparently made to prevent and retard the expenditure of every dollar, and to keep track of it until it is lost in the dim distance—and then to have a string to it that will pull it back if there is any question about its proper expenditure.

The fundamental principle in business economy, on the other hand, is when once an expenditure is decided upon, to complete it in the shortest possible time so that every dollar may be earning interest in the new form with the maximum celerity and the minimum loss in the stage of transition.

The official and the commercial ideals are evidently diametrically opposed. Whether, after all, the Governmental method secures greater honesty, or less scandal in connection with disbursements, can best be judged by a comparison of the history of the Government bureaus with that of our great business or engineering enterprises under corporate management.

In modern ordinary affairs, further, the principle of "audit before payment" is adopted; that is, a certain total expenditure for the execution of a carefully matured and fully planned project having been decided upon, that expenditure is authorized as a whole and the administration of details is left to the responsible managing official. This official, indeed, is chosen largely because of his skill and success in directing such expenditures. The responsibility of the disbursing officer is confined to being able to produce either the cash or properly approved vouchers therefor when his accounts are audited. The managing officers of the corporation which he serves are responsible to their principal or principals for their wisdom and discretion in ordering or approving the disbursements.

The Governmental audit system, on the contrary, is based upon the principle of audit after payment. The disbursing officer is responsible for any errors that may have been made, even after the audit of

his accounts, which may not be completed until months or even years after the expenditure. The result is that this officer and his subordinates naturally scrutinize most critically every disbursement, *going even to the extent of practically interpreting the spirit of the legislation authorizing the expenditure.* It is evident that a multitude of questions will necessarily arise in the conduct of a large constructive work that seemingly must be decided by those responsible for its execution, and that the work will inevitably be delayed and hindered if their authority and right of action is continually called in question by the disbursing officers of another department, who are independently responsible and have no interest in the final result produced. The outcome infallibly will be that the discretion, the foresight, and even the constructive ability of the nominally responsible chief are in great measure reduced to the calibre of department clerks.

During my connection with the Panama Canal, interference of this kind exercised by the young disbursing officer of the Panama Canal, who held the rank of a lieutenant in the Navy, was a constant source of delay and annoyance. While this has been partially rectified by the employment of a civilian as the disbursing officer, these fundamental conditions have not materially changed, and after that officer has had his accounts finally audited by the Treasury Department officials, and some of his payments disapproved and charged against him or his bondsmen, the probabilities are that his apparent efficiency will not be of any higher order than that given by the regular Commission disbursing officers.

A few examples may be interesting in illustrating the Governmental way of not doing things:—

I endeavored to encourage the importation of labor to the Isthmus from the surrounding islands of the West Indies, and sent out agents to various points to secure and forward to Colon such labor as could be secured. The payment of the initial transportation charges by the Government was an absolute necessity. Under the Treasury Department regulations, money could not be advanced to these agents to pay their own personal expenses, let alone the transportation bills. I was at first informed that the only way this could be done would be to procure a receipt from a steamship captain for the transportation, and that I, as chief engineer, and my subordinates, would have to certify to the number of laborers that had actually been received into the Government service, and so arrange that the amount of money advanced for transportation should be deducted from the laborer's pay. As these laborers were irresponsible negroes, and could not be

compelled to go to work after reaching Colon by any legal method or moral influence, the impracticability of this requirement is evident. It was, of course, necessary to have an extensive correspondence and discussion of this question, which consumed many weeks; and even the delay in getting the vouchers properly signed and approved required so much time that frequently the steamships or sailing vessels that brought this labor to Colon were obliged to leave before they could secure payment. This resulted in the masters of the vessels refusing to bring the laborers to the Isthmus, and demanding advance payment at the point of shipment. This, with other impediments to the obtaining of labor, prevented the securing of an efficient force to accomplish, during the dry season of January, February, and March, certain preparatory work which necessarily had to be postponed for another year. Various other instances occurred in my experience, and while these matters are now supposed to be adjusted, other complications will be continually arising which will cause like delays in the future progress of the work. It is perhaps unnecessary to burden this article with further illustrations.

It should be apparent to every thinking man that when the work must be conducted 2,000 miles away from a seat of government, a policy imposing the necessity of referring all important questions to Washington—and submitting them there to men who necessarily cannot be conversant with the conditions on the Isthmus unless they are informed by the parties on the ground—cannot give satisfactory results, no matter how honest or efficient the supervising officials may be. I may perhaps feel too strongly on this point; but my experience at Panama—my occasional contact with Governmental methods reaching back to a service of five years as assistant engineer on river and harbor improvements—has convinced me that attempts to carry on constructive works under the direction of Washington bureaus—especially when the work is large, complicated, and distant from the seat of government—are conducive to extravagance and waste as to both time and money. I am emphatically of the opinion that Governmental functions on the Isthmus should be confined exclusively to a general supervision of the work, and enforcement of such simple ordinances and sanitary regulations as may be necessary to secure the peace, and the health of the community affected by the constructive work.

Various suggestions have been made as to building the canal by contract work, particularly as to dividing the work up into small sections and letting it out to a multitude of contractors. Such a plan

would raise up a multitude of more or less antagonistic, or at least jealous, interests, leading to endless confusion and little, if any, gain in efficiency over the present methods. The situation at Panama is peculiar. If it were simply a canal to be constructed through a comparatively flat country where the excavated material might be thrown on the banks, the small-contract system could be adopted; but the case is totally different. The crux of the work is the Culebra cut, which, in the case of the high-level canal, will be from five to eight miles long, and this work would necessarily have to be under one contractor. The Panama Railroad and the machine shops would have to be subject to that contractor's control, as the material in some cases will require transportation the entire distance across the Isthmus. The question of control of the commissary, the rate of wages paid by the sub-contractors and a host of other details, make it necessary, to my mind, for a single contracting organization to control the entire work.

The fewer the specifications, the more simply they can be drawn, and the larger the amount of authority which can be left to the contractor and his engineers in designing and executing the details of the work, the less will be the cost and the shorter the time for completion. While the tendency will be to make the specifications most elaborate and to place the work, even to its details, under the close supervision of men employed directly by the Government, the best results will be obtained if the authorities in control of the undertaking can guard against the bad effects of this tendency. I firmly believe that if the work is thus contracted for, a sea-level canal can be constructed in as short a time, and for as small a cost, as in the case of a high-level canal built immediately by the Government, with hired labor under the direct supervision of its agents and as the work is now organized.

Originally the problem at Panama seemed to be one of engineering, and the lack of well authenticated data and the inaccessibility of the situation, due to distance and climatic conditions, naturally caused the engineering profession (on account of the interest always taken in a projected public work of an important character) to advance all sorts of theories, to suggest multitudinous plans, and to conjure up difficulties of immense proportions in the carrying out of the other plans or ideas suggested by professional rivals. The data collected and the examinations made by the French engineers, and the investigations carried out under American control, have dispelled the mysteries surrounding the geological formation of the Isthmus; and the problems of the control of the Chagres and of the diversion of the

streams interfering with or paralleling the line of the Canal, with the subordinate engineering problems involved, have been found capable of very practical solution. The engineering aspects now excite interest only on account of their comparative magnitude. The removal of material from the Culebra section is simply the same as if it were a railway cut on an immense scale; but the problem is not one so much of excavation as of the transportation and disposal of the spoil, and of so organizing the work as to permit the maximum number of excavating machines to be employed simultaneously and to be continually fed with car equipment, in order that the maximum efficiency per unit can be maintained. It is, in short, a railway engineering problem.

Now that we see light as to the solution of the engineering questions, the proposition is one of administration. The whole subject is rapidly changing from an engineering to a political phase, and there is a tendency towards delay, unnecessary expense, and possibly scandal, due to the political environment. Careful consideration should be given the prevention, elimination, or modification of these dangers, so that this great work may be accomplished speedily and efficiently, and without the scandal and damage to reputations which seem so far to have been associated with the enterprise.

By politics I do not mean the attempt of men of influence in the political field to secure positions for adherents. As a matter of fact, during my connection with the work I saw nothing of the kind. I never had a request from a Senator or Congressman to make a place for a protégé. In any case, this can be guarded against in a large measure, by civil service rules and proper adminstrative methods. I am using the term "politics" in another sense. For instance, there might be questions of "public policy," which would influence us to sacrifice results in order to secure an early completion of the enterprise by the adoption of an inferior plan. It is to be borne in mind that the general business interests of the country are liable to watch every movement made by the Government in connection with the work, to see that no steps are taken that are adverse to American interests; but this tendency may go farther and lead to strenuous effort for precedence in favor among the larger private interests. This is particularly likely to be the case, as the men representing these large interests have more or less political influence or have the ear of the Administration at Washington at any and all times.

An example of this might be cited in the pressure brought to bear on the Administration to confine the purchase of supplies to the

United States, which prevented the purchase of steamships suitable for the business in foreign markets and confined these purchases to a narrowed field, with less competition and hence higher prices, in order to favor American bottoms. Another factor which might be cited is the application and enforcement of the eight-hour law. This question, which might be called a purely political one in a sense, has already been settled in a way that will increase the expense and delay the work. Again, the engineer in charge might make requisitions for machinery of a particular manufacture, with the efficiency of which he is thoroughly familiar; and the supply of the much needed apparatus might be delayed, owing to the fact that some rival desired to secure the introduction of his machinery—which he would claim, and doubtless believe, to be equally efficient. This new would-be seller might find it necessary to secure what he might call "proper recognition" through the services of influential business connections, or possibly members of Congress or Senators from his State or sections of the country, to assist him in getting a hearing through influential members of the Administration. Such a course would undoubtedly seem proper to him; but it would all result in confusion and delay, and in the possibility of the person in responsible charge of the work being eventually required to use machinery or appliances with which he was unfamiliar, and with the efficiency of which he would not be thoroughly satisfied until after time had been consumed in investigations or experimental use. An example of this might be cited in fact that the late chief engineer, and the present one, were practically satisfied in their own minds that the material from the Culebra excavation could be most efficiently handled by loading it on flat cars of large capacity, plowing it off, and spreading it out by machinery with which they both had had a wide experience and were perfectly familiar. This led the late chief engineer in the autumn of 1904 to recommend the rejection of all the bids which had been received for various dump cars. The pressure, however, brought to bear upon the Commission and the engineer resulted in experimental orders being given for four or five different cars, so that their relative efficiency could be demonstrated by active practice. Or, I might cite the conflicting interests of the producers of the various kinds of fuel, involving in turn the selection of power plant and machinery—whether coal, oil, or the utilization of electricity to be generated from the water power made available through the construction of dams.

As the business interests which would be benefited by the final result are necessarily powerful and capable of commanding the ser-

vices of influential men to advocate their claims, and this influence can be brought to bear upon the various officials situated in Washington—Canal Commissioners, Chairmen, Secretaries, the President, or even of Congress itself—and upon public opinion moulded by the press—and ultimately, through these sources, either singly or combined, upon the responsible person in charge of the work on the Isthmus—the ultimate result can be easily imagined. It is as true today as it was in biblical times that "wheresoever the carcass is, there will the eagles be gathered together."

How widely different would be the result if a private interest were charged with the responsibility of this undertaking, or if it were possible, either directly or indirectly, to place this work in the hands of one man, who would be subjected to no influence except the desire for a speedy and economical completion of the great work, and he alone could finally decide as to the best course to pursue and as to the best means to adopt, either in the employment of men or of machinery, influenced by no motive except economical efficiency! It is evident that this duty cannot be satisfactorily performed by any official of the United States Government, no matter how high or how low, whose tenure of office is affected, directly or indirectly, by popular suffrage, or who might find it to his interest to placate the members of Congress, the press, or powerful influences, in order to favor other public measures in which he may be interested, either as a statesman or a politician.

During the year I had charge of the work on the Isthmus, I endeavored to conduct operations so that the work of preparation, providing for the employing of men, and the experimental studies of construction, should go forward evenly balanced hand in hand. My feeling was that the work should be conducted in such a way as to develop the efficiency of the machinery then on the Isthmus (as compared with that of the American machinery which would be gradually installed) so that data could be established of the relative performance of the men and appliances, the effect of climatic conditions, the value of various forms of labor, the cost of handling various classes of material, and the use of different methods—training and discipline of the working force being concurrently built up as one of the consequences. I realized fully that the actual costs themselves were valuable only in the light of most careful consideration of the various factors contributing to form the conditions under which the work had been carried forward. While this system of costs may have been in a measure crude, it was at least based on what might be considered

proper principles; and as men employed on work of this character must be taught proper methods not only by precept but by examples in practical application, I considered the work a training school, the results of which would ultimately justify the course pursued. The principal object was to establish a system of unit costs, so as to arrive at some unit of measured efficiency which could be applied to every function of the work, and by which the relative efficiency, in dollars and cents, of measures, men, and methods could be determined. The system established was such that the unit of measure of efficiency was the cost per cubic yard of mining, excavating, transportation, track maintenance, disposal and disposition of material. The relative expense of the utilization of the various spoil grounds established by the French could thus be easily determined.

The relative cost per cubic-yard haul down-grade to low dumps, with frequent changes, could be compared with short-distance hauls up-grade to existing French dumping grounds. In this connection, it should be borne in mind that the cost per cubic yard per mile haul of material after loading and unloading was an infinitesimally small quantity as compared with the expense of loading and unloading—that is, the cost of each added mile haul after a train is once moving under speed is extremely small. An analysis of the costs as thus separated and tabulated also showed the effect of climatic conditions on labor, and all of the various elements that entered into the work. From this, I considered, conclusions could be arrived at that would very materially assist contractors in determining a reasonable price for which the remainder of the work might be done. The mere cost of the work itself, in any one class of material and handled by any special method in any one month, would not be of itself a determining factor in the light of conditions which surrounded the work; yet taking the year round, it would, in my opinion, furnish the basis of data which would enable a more intelligent approximation of the cost than if such data had not been kept, or the work had not been carried on along these lines.

The ultimate conclusion which was arrived at—and this was not the result of merely professional ideas, but of careful consideration of all the conditions at the close of my year's experience—is that under all the conditions surrounding the undertaking only two courses remain to be pursued. Either the work should be put into the hands of one strong man, with practically unlimited authority, combining the technical and scientific training of the engineer with the administrative and executive ability of a man of force; with this should be coupled

the separation of all matters connected with this work from the control of the ordinary Government departments at Washington—but under such supervision only as to insure the Government that his administration is efficient; or the same result should be accomplished through the letting of the work to a contracting firm, large enough to control under one management the entire constructive work on the Isthmus, under broad and general specifications and under such general supervision as may appear to Congress to be proper. The first step of any contracting firm would then be to place its affairs in the hands of a strong single executive, supported by such advisory technical knowledge as might be deemed necessary. The precedent for this method, and a working application of this principle, is the special agreement which was made for the construction for the improvements at the mouth of the Mississippi under Capt. Eads. It was a contract which bound the contractor to nothing but certain results for a certain sum, and no more satisfactory compact for public work was ever made by the United States.

I feel that only in this way, or some substantially identical way, can the construction of the Canal be successfully accomplished. While the work may be completed at some time, and at some cost, by the poorest and most inefficient method—even by hired labor under Government control—the accomplishment will be far from satisfactory. It goes without saying that if any large American corporation were engaged in the business of constructing a great public work for the purpose of furnishing transportation, unhampered by political questions or public opinion, the work would attract practically no attention, except the ordinary interest connected with an engineering project of great magnitude. It is a fact of which the public is not aware that many of the large railway systems today are spending as much money annually, in the improvement and operation of lines of transportation providing for the handling of tonnage much greater than that will pass through the Panama Canal, as will be expended on the Panama Canal, and their operations proceed with hardly a newspaper notice. While employed as the general manager of the lines of the Illinois Central Railroad, I was responsible for the expenditure of more money per annum, and had more employees engaged in it, than would ever be spent and ever be employed on the Panama Canal in any one year.

It may be argued that commercial interests would suffer by placing the Panama Railroad under the control of a general contractor, and that it will be difficult to secure the proper direction of its obligations

as a common carrier. The result of the operations during the last year would indicate that it would be difficult for any contractor to produce more *un*satisfactory results.

The plan suggested in my official communications on this subject was that of operating the Panama Railroad as a simple transfer organization, whose sole duty as a common carrier would be to receive the freight delivered at its ocean wharf on one side, and deliver it at the ship dock on the other side, for a flat rate per ton—regardless of the classification, except so far as the cubical contents of certain light articles would be made equivalent to a ton. The proposal is simple and perfectly practicable. The forwarding agents of the world would thereafter bill all goods over transportation lines using the Panama Railroad as an immediate transferring link on their bills of lading, subject to the transfer charge across the Isthmus of Panama; this could be collected by Government agents, either from the steamship line delivering the freight or the one receiving it. In this way no complication of accounts would be necessary, and all commercial interests would be treated with equal fairness. It would be a simple, normal, and logical introduction to the conditions which will exist when the canal is opened, and rail trans-shipment gives way to through passage of shipping under a tonnage charge. One of the most strenuous objections raised to the proposition was that "it would unsettle Transcontinental rates." If this is to be a final and determining reason—why are we building the Panama Canal?

After the proper facilities have been provided in the way of docks and wharfs, double-tracking of the Panama Railroad, and providing it with modern equipment, as outlined by me when in charge of the work on the Isthmus, there will be no difficulty in a general contractor easily, promptly, and economically handling all the commercial freight, without any interference with the Canal construction work; particularly if he has the absolute control of both, and is held accountable only for the proper performance of the duties of a common carrier, and is not subjected to trivial interference.

The questions of local rates and the charges to be made for this service by the contractor are simple, and easily adjusted; it would seem a brilliant opportunity for the United States Government, either through its Interstate Commerce Commission or otherwise, to experiment with the regulations of rates across the Isthmus and the general control of the operation of the Panama Railroad, and acquire some experience therein before attempting to tackle the complicated problem of regulating the rates and controlling the methods of doing

business on the 200,000 miles of railway which interlace and ramify throughout the United States. The transportation-rate problems of Panama, as compared with those of the United States as a whole, might be likened a single grain of sand compared with the whole seashore.

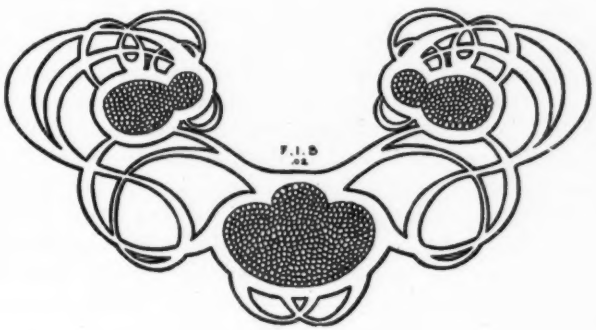
Presumably the reader will recognize the fact that many men in advanced years have looked back on the simple Utopian ideas of their youth with a smile, after they have come in contact with the cold, practical world. When any man, no matter what his age, arrives at a condition in life when he is beyond or above errors, does not make them, or making them is not able to recognize that they are errors, and is not strong or intelligent enough to admit that they are errors—it is time for him to depart to another planet, where he can either find something to learn or be employed in a larger field of usefulness.

If the experience had not been so serious, I should look back to my first connection with this enterprise and the experience gained therewith, and smile to think I had been so innocent as to suppose myself able to overcome the long-settled influences heretofore indicated, or to impress my individuality upon the work or employ in it the methods with which I had been familiar for years. The usefulness of any man who might be called in as an engineer of demonstrated capacity to supervise an enterprise of this character is naturally measured by the extent to which he may be permitted to use his own methods and make avilable the result of his past experience. To expect that any person who is really qualified to conduct the work will radically change his methods, which have been the outcome of a lifetime of experience, and adapt himself to moss-grown Government methods, is to expect the impossible. It demands that a man should be content to ignore the instincts of his profession, and to subject himself to the various influences brought to bear upon him, drifting along in a perfunctory way, satisfied to draw his compensation, hoping that in some way or other he may be able eventually to see the work completed, or wasting the best years of his life in the partial accomplishment of it.

The writer desires to take this opportunity to state most emphatically to his professional brethren that his resignation from the position of Chief Engineer was not the result of any desire to better his financial condition. No financial consideration would have induced him to lay down this work if, on sober reflection, he could have been convinced that he could accomplish desirable results and that it was his duty to remain. On the other hand, under

conditions as they existed, no compensation to his mind would have justified him in continuing to hold the position. During his year's connection with the work he had, from time to time, to put up with, to condone, and to concur in many things which under ordinary circumstances of professional employment he would not have tolerated or submitted to; and no one can censure him as much as he censures himself to think that he fell into the error of accepting conditions which later matured reflection persuaded him were unwise. During his last voyage to Colon, after six days of uninterrupted thought which the sea voyage made possible, he gradually saw when he was drifting and felt the best interests of the work demanded his retirement and the selection of a successor who would be able and willing to subordinate himself thoroughly to the authority of those above and to the influences which, so far as the writer could see, must dominate the conduct of the office. It was apparent, however, that a resignation in which these reasons were set forth might have an injurious effect upon the project and might possibly embarrass those charged with its consummation.

If the events which have followed in the train of the writer's resignation have caused public attention to be drawn towards the situation surrounding this great undertaking, and shall lead even indirectly to its proper demonstration and conduct, the writer will be content, even at the cost of the apparent misconstruction of his motives and of the attacks that have been made upon his reputation. He desires to add, however, that he had not accepted another position prior to his interview with the Secretary of War, and had declined to consider such a proposition except under the conditions that it should be subject to the rendering of all essential service to the Administration, and to the arrangement of a disconnection from the canal work at such time and in such a way as to cause no undue injury to the project or annoyance to the Administration.—*J. F. W.*



THE AMERICAN, AND THE GERMAN, "PERIL."

By Louis J. Magee.

III. AMERICAN TRADE METHODS TESTED BY GERMAN EXPERIENCE.

Mr. Magee's articles have already attracted wide attention, and drawn from able critics the expression that they furnish the best interpretation yet offered of the industrial systems of the United States and of Germany, and the meaning these have for each other and for their rivals in manufacture and commerce.

Particular point is given to their appearance at this time by the menace of a tariff "war" between Germany and America, and by the suggestions wakened through Mr. James J. Hill's recent warning to his countrymen that they are squandering their natural resources without working up markets for their manufactures. The present paper, dealing directly with the question of export trade, its place in the National economy, and the value of foresight in its cultivation, is peculiarly apposite to the times.—THE EDITORS.

A VERY strong national trait with Americans is our infinite trust in the efficiency of a sudden spurt; our confidence in extraordinary effort at critical moments. The German method, whether it may be better or worse, is quite contrary to this. The German organizes always for sustained effort. In Germany the study goes on long before the question becomes acute, and it does not then become necessary for uninformed persons to take up a new subject and apply all their efforts to it for the moment.

There are a great many matters connected with business and industries which cannot be settled quickly; among them are not only the solutions of technical problems, but also many matters connected with internal organization, sales, treatment of customers, and all that makes for tradition and custom in trade, and especially the questions connected with the treatment of employees. Some of the larger German firms have departments devoted to what they call *Wohlfahrt*. One of the members of the *Directorium* of Krupp, for instance, handles all questions referring to social problems and anything that is done in the interest of the employee. The interest of this department in these problems is perennial, and those who have this department in charge become expert authorities on their subject, just as other members of the directorate are experts on the subject of guns, armor-plate, or finance.

No matter what brilliant examples we may show to the contrary, we have yet to learn as a nation that the bright, shrewd man may

most utterly fail in such situations, and the slow, well-informed man must come in and do the work. We should not put too much upon any one important man, but so organize as to have expert colleagues whose knowledge can supplement and complete our own. The names of officers in German companies appear neither in the advertisements nor on the letter heads. Correspondence is almost exclusively in the name of the firm. All transactions and discussions are scrupulously recorded. Everything is planned on the principle that the corporation is greater than the man.

One of the hardest things for an American firm, which has been very successful at home, to appreciate, is that it must make concessions to foreign customs and ways of thinking, if it would do business abroad. We do not deserve so much credit for the cotton, the grain, and the petroleum which we export; Europe would purchase these articles from us, in any case. Every sale, however, of manufactured goods which we make is a greater credit to our intelligence and energy, and, in some lines, a credit to our tact and thoroughness.

Now as to some of our weak points in American practice as they appear to those used to European methods of doing foreign business.

It is very difficult to get concise information regarding American products in such a shape that it may be intelligently used at a great distance from the base of supplies. Much of our most excellent manufacturing and engineering home business has been built up by agents who were in close touch with the chief officers, and by officers in close touch with the factories. The agent has frequently been, and is still, in some cases, ignorant as to important details, and his chief business seems to be to find out the relative importance of the customer and the probability of his immediately placing an order. If the customer asks searching questions, the agent has to get the information from the technical staff. It is very likely creditable to the American business man that inquiries are followed up pretty generally with personal visits. It would seem, however, that agents often think that they are helping the business and entertaining the prospective customer by making abnormally long visits and volunteering a great deal of *verbal* information. This method is for the complex industrial life today becoming antiquated and provincial. It is the engineer's province to inform himself as to the tools and materials which can be used to accomplish the ends before him. Therefore, the descriptions and price lists cannot be considered just whenever the agent happens to hand them in, but should be so concise that they require no discussion

whatever, and will speak for themselves when the time comes for decision regarding them.

Many American manufacturers have an absurd idea that they will suffer harm if they print prices in their catalogues. This practice is very irritating, as so much time is wasted in getting at the prices, and the prices are so frequently given "with hems and haws." If a firm has an article which can stand competition, and makes a list price which shall be subject to moderate discounts such as are customary in international traffic, it may be fairly assumed that the widely distributed prices will do much more good than harm. There are many thousands of careful readers throughout the world studying your advertisements and your circulars, and some of these will place orders, through their correspondents at home, if your literature puts them in a position to do so with a certain degree of intelligence. An engineer may have upon his desk your circular explaining the many advantages of your oil, your belting, your engines; but if you have not told him the prices, he can come to no decision through your other claims, and he is likely to purchase from some firm which gives, without the asking, the information he requires. Any close observer of advertising methods must notice that as technical enlightenment increases and as the people in general read more about scientific progress, the trade advertisements that help most are those which contain basal facts.

In short, the German industries show a tendency to be instructive in their advertisements and to be very explicit and complete in their circulars. A good rule for every American manufacturer who hopes to have his goods sell beyond the limits of his own ken, is to describe those goods in all essential features in exactly the way he would want them described to him if he had never seen them and were forced to decide upon their use, and incorporate them in his work, in Madagascar or Chili.

American printed matter is excellent; the paper and type is good, and the artistic covers usually in much better taste than those produced by the old art countries of Europe. These delicate and sometimes very beautiful catalogues have undoubtedly an advertising value, but a luxurious picture book does not satisfy the distant engineer who is getting together a large plant from many elements. He would much prefer half a dozen pages of dimension diagrams, and tables of prices, capacities, efficiencies, etc. It is a fair question for every manufacturer to put to himself: "Do you think

that you can ultimately fool the technical public?" if not, tell them beforehand all that they could probably under proper conditions of operation and use find out for themselves."

If your product is as good and cheap as that of your foreign competitor, and your agent as tactful as his, then your success will depend largely upon your guarantee and your specific statements, the explicitness of your tender, and the clearness of your descriptions. European purchasers are accustomed to figure closely on efficiency and depreciation. The average American has a tendency to evade these subjects. Frequently the cause is that the purchasing public here has in the past been very lax in imposing conditions. The cleverness of agents has sufficed to furnish enough information both for the purchaser and the furnisher. This condition seems to be rapidly changing, but obtaining information from some manufacturers in this country is still like the operation of extracting teeth.

Another point in the export business in which some of our American firms could take lessons from Europe, is the subject of payments in general. A great deal has been written about our harshness in demanding payment against bill of lading; that comes from our ignorance of foreign conditions and the fact that many of our firms which produce articles adapted for export, are satisfied with their success at home and personally disinclined to interest themselves in foreign conditions. The Germans are in much closer contact with the remote countries, partly through the export houses of Hamburg and Bremen, and partly through the rapidly multiplying bank connections with foreign countries; this same is also true of England. Aside, however, from the question of cash payments—which are very good as long as you can get them—some of our firms seem to be rather arbitrary as to the changes in prices. The necessity of holding a tender open until it could reach the person it was intended for outside of this country, seemed recently to be an entirely new thought to the agent of one of our largest firms.

Practically all German observers have dwelt emphatically on the wisdom of the American tendency to specialize on certain types. Perhaps in the general acceptance of this doctrine we have sometimes gone too far. There are many wants in the world which cannot be met with normal existing types, but, in spite of that, offer a basis for profitable business. There may perhaps be a golden mean between the almost dictatorial offering of a normal type which has made many a firm successful, and the willingness to build whatever a customer

wants, which has not entirely hindered the development of European industry.

There are many people abroad who would like to use your product, if you would meet them half-way. Europe, because of its own industrial progress, its own advanced enlightenment, and its own complex needs, must always be looked upon as customer as well as competitor; we never shall get along without Europe. I feel certain that many of the export sales of which we are so proud, are due to the intelligence of the Europeans in finding out what good things we had, rather than to our own commercial activity in bringing about the sale.

An enterprising German manufacturer found a novel machine tool in the United States, and took the selling agency for it abroad. It now appears that he has, to the astonishment of the American maker, sold more of these machines in Europe than have been sold in the United States. A New York exporter remarked casually that he had, within the last five months, shipped one hundred car-loads of *high-grade* machine tools to the Continent. All of these were sold through an agency of Germans with headquarters in Berlin. These good Continental *customers* were at the same time, he said, proving invincible *competitors* on other types of tools, in South America.

We should never be blinded by the wholesale figures of our exports. After subtracting the raw products like wheat, cotton, petroleum and metal, we might go further, if we knew all the circumstances, and subtract some manufactured articles which, through peculiar circumstances, have found a large market abroad. Industrial America, on the whole, can be proud of its export business only when every factory can, with profit, place a certain percentage of its output in the foreign market. The important conditions upon which this result depends are, first of all, good quality of the product for the price asked; second, efficiency in selling organization; third, promptness and constancy in delivery; fourth, exact and prompt methods in correspondence; fifth, far-reaching and reliable financial connections.

American firms should do more to facilitate the use of foreign languages in their offices and publications. This has long been the theme of consular reports, but we are not yet sufficiently cosmopolitan in this respect. Our inevitable change to the metric system of measurements can of course not take place without some throes, but the longer we postpone it the harder it will be.

If I were making a suggestion to American firms who have not yet attempted to export much, or have not yet succeeded, I would say

that our chief shortcoming in comparison with English and German firms is wont to be our lack of real knowledge of the market. We are liable to be superficial in dealing with foreign situations, inasmuch as most of the leading men in our country are occupied with a complexity of affairs which goes quite beyond their own official business. Many such leave their export business to people who have not sufficient power to act aggressively.

In all their business successes the Germans are (with the exception of some bigoted beaureaucrats) seldom conceited. In contact with English and Americans they are conscious that they are often disliked and misunderstood. They even criticise themselves sometimes as being unintentionally austere, narrow-minded, insistent in small things. But they have learned frugality in a long struggle. Their honesty is proverbial and deserves to be. Germans too often hide splendid talents beneath an unprepossessing exterior. They have this to fight against in international intercourse; but as a rule they have only to be known to be appreciated. They are, in a high degree, objective, thoughtful, pholosophic. These qualities make for the rule of right and reason. The class more especially identified with the nation's recent commercial activity, namely the merchants, captains of industry, financiers, business lawyers, leading technical and other professional men, are, as a rule, precisely informed, unostentatious in bearing, quiet and forceful in address, tireless, devoted workers, fruitful thinkers, and often masterful in combination.

After fifteen years spent in their midst, I am convinced that they are more liberal and kindly, more straightforward and reasonable in their demands, than the outside world at large believes them to be.

Urging to greater effort within their borders, the Emperor gave his people the noble motto: "Limited toward the outer world; unlimited within." It is, indeed, this vast possiblity of development of German culture, skill, and efficiency *at home;* this infinite refinement of quality; this gradual increase of forces through studied organization, which will more and more engage the attention of the world. But even across this brilliant prospect lies the cloud-shadow of agrarian opposition.

We all have our weak points, and the oft announced "peril" does not seem imminent on either side. We have not invaded the world's markets in any such way as to alarm the strongest elements in Germany. Our natural resources, combined with our peculiar national forces, constitute a power which, directed in a certain

way, might bring about the struggle of the ages. Germany—clever, thorough, virile—lacks our resources. As a compensation, Germany has gotten down to a recognition of fundamental truths in a good many matters where we are still groping. If we were to exchange territory with the Germans, each people taking along all their own institutions, their government, their methods, America would perhaps in some respects become a still greater danger than it is today. I believe the two nations are going to understand each other better, and "get together" in many future situations.

Mommsen, in his last public statement, said:

> "All State government consists in the compensating of opposing interests; in the bringing about of such conditions that the rival tendencies are made to agree tolerably; no party having fully its own way, and the community being balanced."

This applies to the realm of world trade as well as to home government. Constrained by their own troubles and by their ultimate appreciation of each other's strength, the great industrial rivals ought, indeed, to "agree tolerably."

THE SQUARE DEAL IN WORKS MANAGEMENT.

By O. M. Becker.

III. WHAT CAN BE DONE WITH THE WORKERS.

Mr. Becker's series began in the issue of this Magazine for January last; the first portion dealt with the "common-sense of the management of men," and the second with adaptations suggested by modern ideas concerning chiefly the design, arrangement, or structure of the shop itself. The various phases of "welfare work" are necessarily interwoven and overlapping, but the present installment of the discussion takes up shop institutions which have to do more particularly with still later conceptions of the economy of fostering and conserving the physical energy of the employee.—THE EDITORS.

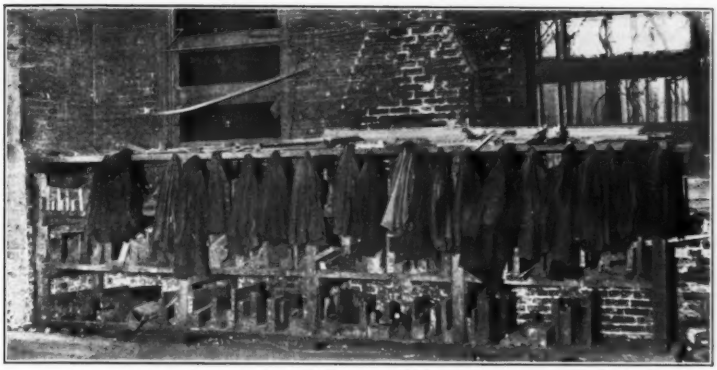
THOUGH the expediency of elaborate shop fixtures and equipment may be open to some question, there can be none as to the expediency or even obligation to provide simple sanitary appliances (and facilities for their use) for preserving a degree of cleanliness and for conserving the decencies. The lavatory arrangement very properly is supplemented by suitable arrangements for taking care of the street garments and personal belongings of the workers. Except possibly in case of those rare occupations where absolute cleanliness prevails from the nature of the work itself, the working girl wears better clothes on the street than at her work. Even in the exceptional case there are occasions and seasons when outer garments are necessary, and must be taken care of during the work day. The manager could have but little regard for decency and womanly modesty who would decline to give his women employees so much as a little corner wherein the change of garments could be made in privacy. It seems almost beyond belief that in these days women employees should be obliged to make any such necessary change of clothing in the presence of men; but that there are such instances is as certain as it is incredible. Unless his establishment is small or of recent construction many a manager might find to his surprise, did he make an inspection tour at a suitable hour, the shop garments of women and men indiscriminately strewn about a dirty floor just where they had been stripped off in some of the shops, as did a certain superintendent well-known to the writer. It is not at all surprising that under these circumstances, or any at all approximating them, modest women should refuse to remain in such places, and that vice should thrive. The charge sometimes still heard that

certain factories are little short of brothels is all too often founded upon too much fact; and the responsibility for such conditions is wholly or very largely upon the shoulders of the short-sighted management which has more regard for a dollar than for a woman's modesty.

It would seem therefore that a dressing room, where women employees may have some privacy, is one of the essential requirements of a decently managed factory using work people of both sexes. And if there is a responsibility in providing these for women, why not also for men? Whatever answer may be made to this question, it is surely open to no doubt that a workman has a right to go home with clean clothes, as well as clean face and hands. Obliged to hang his hat and coat to a nail in the wall, to catch the dust and grime of the shop, as is yet very commonly the case, there can be little incentive to personal cleanliness and neatness in other things.

Apparently the least that can in reason be done by an employer is to furnish inexpensive wooden cabinets along the walls of the shop. If there is a wash room or changing room, of course the cabinets or lockers will be better placed there. In some instances racks and hooks alone may be found sufficient for use in a dressing room. Such an arrangement has the disadvantage of affording no privacy, no place for leaving personal belongings that cannot be hung up, and of offering temptation to the dishonestly disposed. Wooden lockers or closets may be the best arrangement, if it is found necessary to have them along the walls of the dusty shop—though indeed it would seem that sufficient space could always be found for a small locker and dressing room, even in crowded shops. Such cabinets are not very sanitary, however, being hard to clean and lacking ventilation. When not exposed to dust and smoke, they can be provided with openings for air circulation. Undoubtedly the best arrangement is that wherein expanded-metal lockers are ranged about a well ventilated room used also as a lavatory and sanitary closet room, or at all events connected with them. The circulation of air about the room will ordinarily be sufficient to aerate the lockers and contents sufficiently to prevent staleness. A steam pipe run along the bottoms of these lockers conduces greatly to their sanitation.

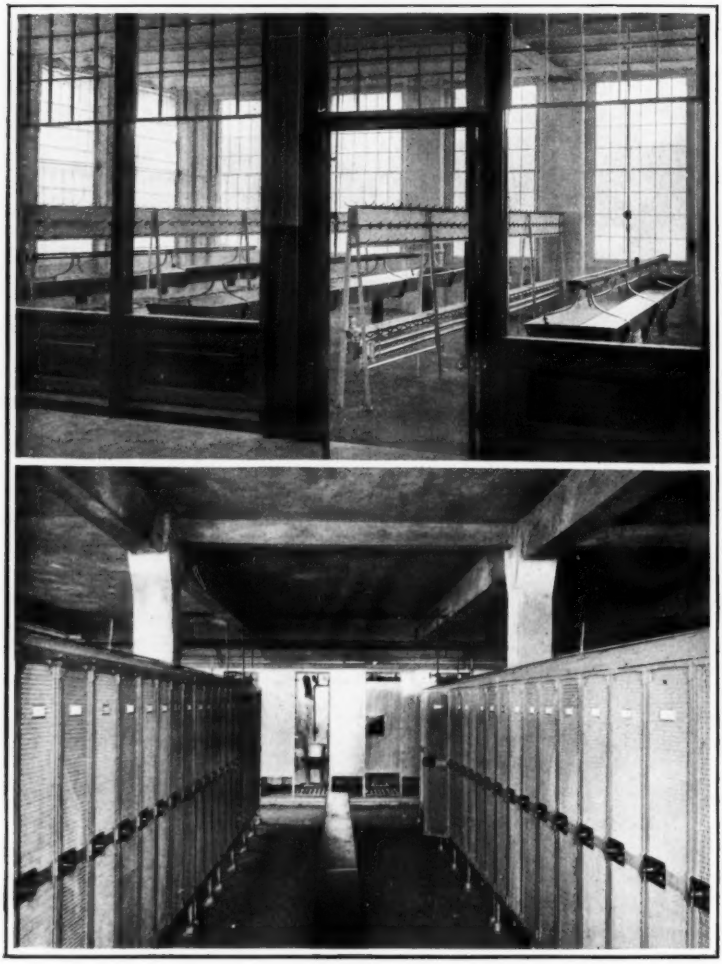
Along with lavatories, lockers, and dressing conveniences, and even more essential than these, go decent sanitary and toilet conveniences. Unfortunately there are still many places where such conveniences are absolutely lacking; and there are many more where they are amazingly crude and consequently also disgustingly filthy and



THE OLD WAY—AND STILL THE VERY COMMON WAY.
The interior of one of the largest American forge shops. Badly lighted, ventilation far from good, and not a locker or wash basin.

unsanitary, as well as positively immoral. This condition is all the more shocking when it occurs in connection with work rooms wherein both sexes are employed, as is not infrequently the case. What could be expected of the *morale* of a mixed working force using indiscriminately the same filthy toilet and wash basins, if any are provided?

A METHOD IN USE IN AN ENGLISH FACTORY EMPLOYING MANY GIRLS.
Large, airy room, for hanging street garments. The lack of lockers indicates confidence in the honesty of the employees. Cadbury Bros. Cocoa Works, Bourneville.



VIEW OF THE WARDROBE, BATH AND WASH-ROOM FACILITIES IN A LEADING MACHINE-TOOL WORKS.

The upper picture shows an equipment of Mott lavatories and steam heated racks for hanging and drying street clothing. The lower view shows the wardrobe and baths connected with the foundry. The door of one of the baths is open, showing the tub and hot and cold water supply. The Brown & Sharpe Mfg. Co., Providence, R. I.

Can anything less be required than separate toilet rooms, clean and decent? In these days of sanitary plumbing, disinfectants, and waste removal it is difficult to conceive a valid reason for the continuance of such disgusting conditions.

A WASH AND DRESSING ROOM FOR FEMALE OPERATIVES
In the H. J. Heinz factories, Pittsburgh, Pa.

The simplest accommodations are usually quite good enough. Indeed, extreme elaborateness is quite likely to be resented. The thing to be insisted upon is cleanness and proper sanitation; and a thing to be emphasized is privacy. The lattter desire can be satisfied at small additional expense. It is perhaps unnecessary to provide individual box closets for the latrines, the semi-private stalls doing very well under some circumstances. The closet is in every respect the more desirable, however. A further requirement is that the toilet be kept clean. The method of installation is therefore of primary importance, and it is desirable that floors and walls be of such material as lend themselves readily to this end.

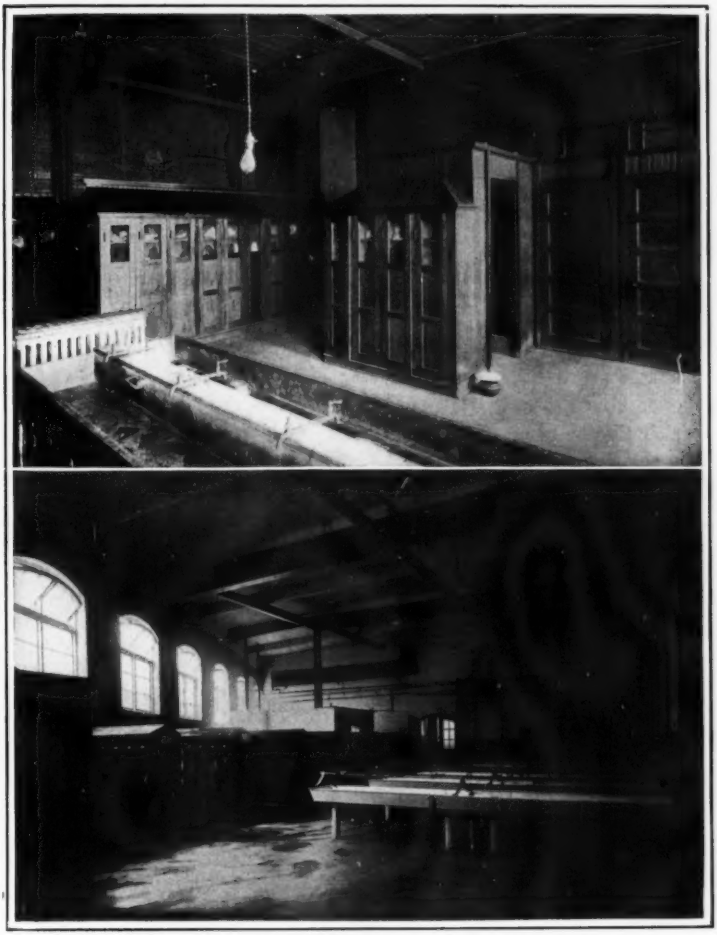
Anything less than the simplest provision here pointed out smacks strongly of the sweat shop, happily now in its decadence. Fortunate it is for the moral as well as the physical side, that sweat-shop methods, whether in the clothing business, the metal industries, or in whatever trade, are going the way of all impedimenta to industrial civilization. Already the shop wherein there is little evidence of regard for the convenience, physical welfare, and modesty of its work

people is regarded with distinct disfavor, as out of step with the forward movement of civilization, a relic of industrial barbarism sooner or later to be eliminated by law if not by the self interest of the responsible ones. The disposition of employers generally to make ample provisions for observing the common decencies is one of the welcome signs of an awakening industrial conscience, and exactly therein lies the beginning and basis of all sane "betterment" or "welfare" activity.

WASH-ROOM AND CLOTHES LOCKERS. ONE OF THE SHOPS OF THE NORWALK IRON WORKS.

The floors are cement, easily washable with a hose. The bowls are large, with large faucets and waste, set low to facilitate washing the face and head, and without flat slab to collect standing water. Designed at Norwalk and since adopted and made by Mott.

The assertion is frequently made that such conveniences as have been mentioned are not appreciated by the work people, and that when supplied they are not much used and are abused. Experience and observation does not bear out the assertion. It conclusively proves the opposite, however. It might of course happen that there would be cases of abuse; but if an effort is made to preserve proper conditions the very force of example compels a fair regard for decency. There is something to appeal to the men and women. The same question came up when the construction of one of the best examples of



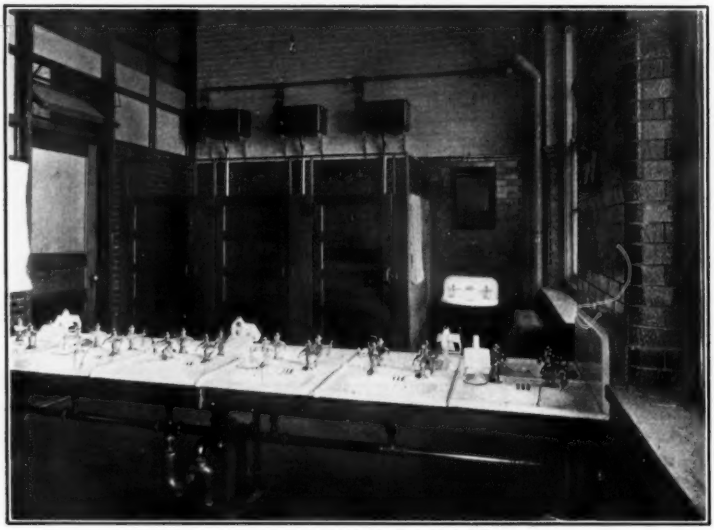
EXAMPLES OF WASH-ROOM AND LOCKER INSTALLATIONS.
Above are shown semi-ventilated lockers of the Sherwin-Williams Company's works; below, metal lockers and lavatories in the new shops of the B. F. Sturtevant Co., Hyde Park, Mass.

sane present-day factory building, equipment, and administration was under consideration. The president of the company* made an investigation covering all kinds of conditions of shops and factories and other industrial establishments. He found that without excep-

* Mr. Edward Weston, of the Weston Electrical Instrument Co., Newark, N. J.

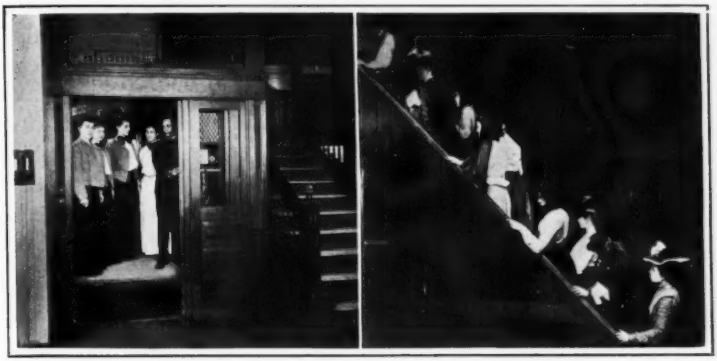
tion, in those places where superior toilet and other accommodations were provided, they were respected and properly used.

Nowadays almost every shop or other place wherein people work, is provided, if the building has more than one floor level, with elevators or lifts for transporting materials up and down. Remarkable as it may seem, until recently it had not occurred to any except a very few employers to allow the work people to make use of these same conveniences in reaching and leaving their respective places of work. Usually employees were, and still are, forbidden to use the lifts intended for materials; and where not forbidden to do so, they are able to make litttle use of them because the elevators do not run before the workmen are expected to be at their places and are shut down immediately the quitting whistle blows. The importance of running the elevators a few minutes before and after work begins and ends, a practice involving practically no expense, does not seem to be realized as it should be. Climbing stairs is very fatiguing work, especially for women. After climbing several flights of stairs a girl starts into her day's work handicapped by a fatigue greater than would result from several hours' labor at her regular work—a handicap as unnecessary



A HAPPY MEDIUM IN THE WAY OF WASH-ROOM APPOINTMENTS.

Bowls, plumbing, and closets of approved but comparatively inexpensive pattern, and thoroughly sanitary. Girls' wash room, McCormick Twine Mills, Chicago.



WHICH PARTY WILL ARRIVE BEST FITTED FOR ENERGETIC WORK?

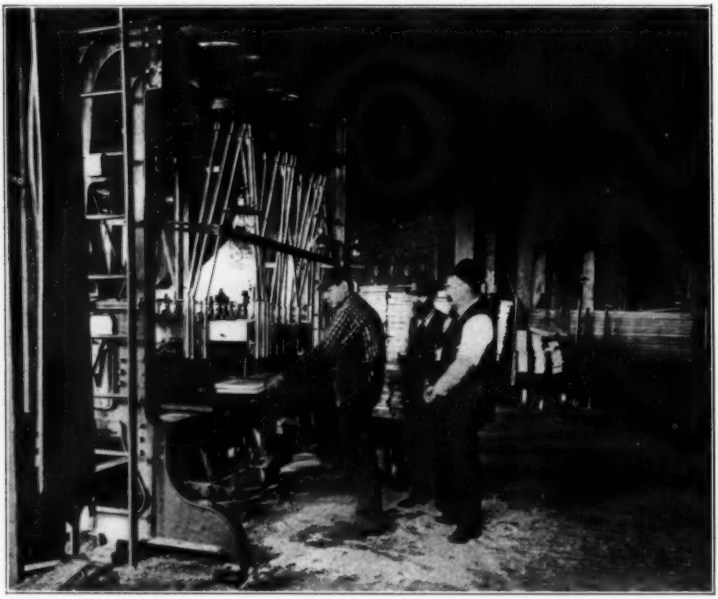
The usual mode of getting to the upper floors of a factory is by climbing several flights of stairs—an effort requiring much of the workers' energy. The elevator, where practicable, certainly adds much to the daily output of workers on the upper floors.

as it is wasteful. The same thing precisely, though possibly in a less degree, is true of men. There is no reason why energy should be wasted in wearying the muscles, even though they be the muscles of work people, when appliances are at hand which could do the work much more economically or when such weariness could be prevented just as easily as not.

Furthermore, it is in many cases necessary for workmen to change floors frequently for one purpose or another. The much climbing of stairs is an unnecesssary drain upon their vitality. If ordinary elevators are not available, and out of the question, there are other expedients that serve the purpose very well. One such, in rather common use in western flour mills and grain warehouses, and now coming into use in factories also, is modeled upon the hod elevator utilized in building construction. An endless chain or belt running vertically through the several floors at a suitable speed, is provided at convenient intervals with projecting rods and shelves or steps. In use, the passenger steps on one of the moving shelves or steps and at the same time grasps a convenient handle, rides to his floor, and steps off again. Such an arrangement obviously might permit accidents, unless well safeguarded. There seems to be no reason why these safeguards cannot be provided. At any rate the device is inexpensive and useful.

The amount and quality of work turned out depends very largely upon the physical condition of the worker. A sick man accomplishes little, and a tired man cannot do his best. It is therefore of specific

economical importance to conserve as much as possible the health and strength of the worker. If he is required to do things in connection with his work that unnecessarily tire him and sap his vitality, the employer loses thereby, and loses needlessly just in proportion as the condition is remediable. Many operations are of such a nature that the operator could sit just as well as stand; and there are very few indeed that do not admit of the worker sitting or otherwise resting at



A JOB WHERE THE WORKMAN MUST STAND, TO FEED THE MACHINE.
Some day a conveyor will handle the pieces better, and the man's energy will thus be conserved.

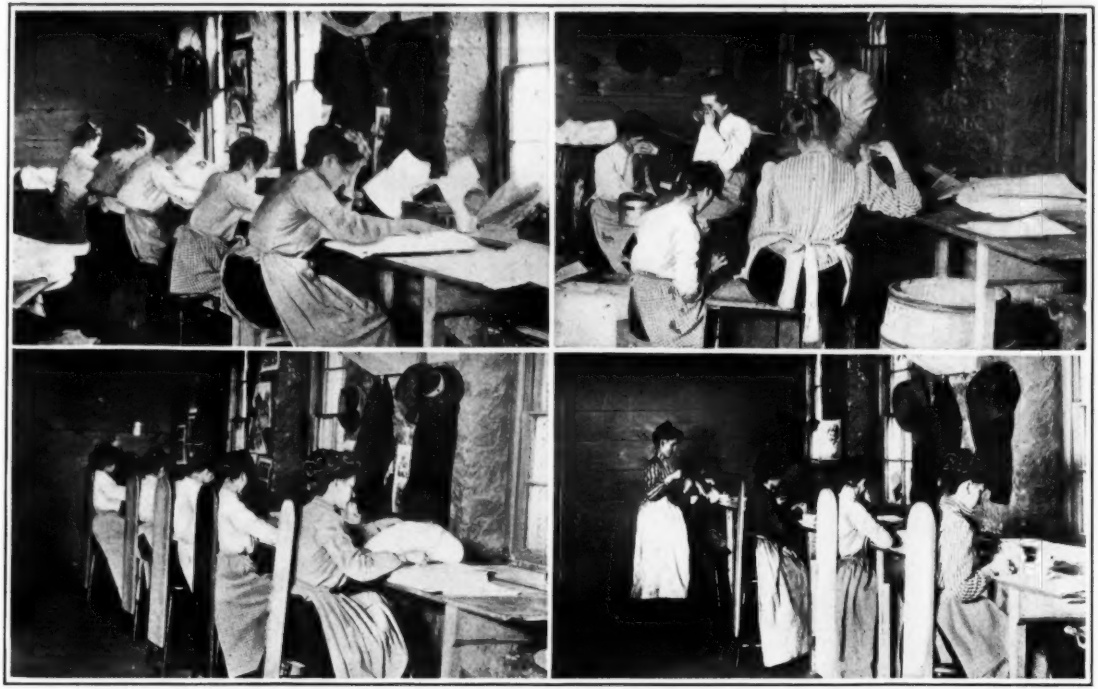
intervals, even if only for a few moments at a time. Possibly some machinery might require, in specific instances, to be re-arranged; but there is nothing inherent in the nature of most jobs that would prevent such a re-arrangement. The clerk in a department store, for instance, might just as well sit as stand while not waiting upon customers or putting stock in order. Often she could with advantage sit while doing her work; and having the opportunity to do so, she will be better-natured and be able to give better service to both customer and employer because not unnecessarily tired and worn out by useless standing. In the factory there is no more reason why a man

or boy should stand in front of a drill press, or almost any other machine, proper provision having been made for bringing up and removing material, than there is for a woman standing at a sewing machine. It is true that some occupations, particularly those involving attention to several machines at the same time, do not permit of much sitting or resting. But even in such cases there are certain to be, or at any rate there ought to be, short intervals when everything is going well so that the operator can for a few moments relieve the muscular tension. An instance of this kind is found in a certain factory whose output is a fiber product. One of the final operations is performed by girls, each one of whom attends to several machines. These girls lead a very strenuous life indeed during the ten hours that they put in daily, and not many are found able to continue at the work.

A CASE OF PROVISION FOR THE OPERATIVES' REST.

A strenuous job—balling twine. Formerly few girls could stand it long, and changes of operatives were frequent. The introduction of stools has permitted the girls to get about 60 minutes rest during the working day, a few moments at a time.

Only girls of exceptionally good physique and endurance are able to do it. These girls have been provided with stools, and it has been found that they are able to make use of them to the extent of about sixty minutes a day, without in any way neglecting their work. The periods of rest are of course very short; but the aggregate is consid-



A SUGGESTION OF EVOLUTION IN SIMPLE CONVENIENCES FOR REST AND LUNCH FACILITIES.

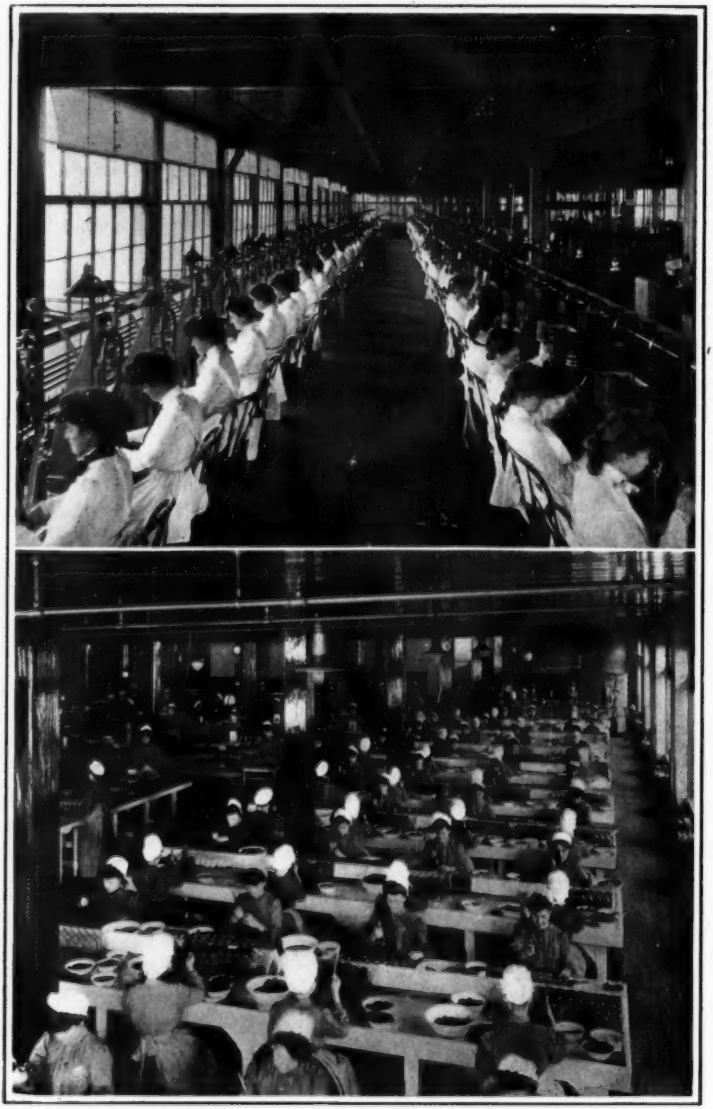
The upper picture on the left shows how wooden boxes may be pressed into service, when permitted by a management which recognizes that more and better work is produced when the worker's strength is conserved. The companion picture in the upper tier shows a similar adaptation to lunch-room "facilities"—crude enough, but by no means the worst offered factory employees. The lower left view illustrates a moderately satisfactory stool rigged up at small expense; the right lower corner, a simple lunch arrangement available where the work benches can be kept tolerably clean, though plainly inapplicable to the machine shop.

erable, and makes a great difference in the physical condition of the girls at the close of the day. It is to be regretted that the employer in this instance stopped short with a half-way measure instead of giving the girls chairs with back supports. The kind of seat has much to do with the rest it gives. A mere stool is good as far as it goes; but to give full benefit it should have back rests, and be of proper height so that the feet of the operator may rest upon the floor, or in case this is impracticable, foot rests should be fitted. But there are many jobs where it is necessary to be frequently, or even most of the time, on the feet, and in such case it is desirable that the stool be of such form as to admit of quick rising and sitting. In the absence of something bettter, an old packing box is susceptible of being made into a fairly comfortable seat.

It is a sad reflection on the intelligence of many a foreman, and even manager, that not only are no seats of any kind provided, but the use of any improvised by the workmen is discouraged, even forbidden. The attitude is of course that seats breed laziness and diminish output. A very little reflection and experience should convince even a slave driver that the more he relieves the unnecessary muscular strain of his workman the more energy is left to turn out work. Office managers generally have recognized the importance of this detail, and factory managers who have not already made similar provision might well take a lesson from them.

The physical condition of the workman of course depends upon many things besides the nature of his job and the extent to which it is fatiguing. The gases, dust, dampness, heat, or similar conditions under which he may be obliged to work, tend to impair his vitality and to breed disease. The amelioration and possible discontinuance of such conditions has already been considered. There are many conditions not under the direct control of the employer, such for instance as the nutrition, housing, and recreation of his employees. All these can be, and in a number of instances have been, successfully brought within the purview of the employer, to the mutual advantage of himself and his employees. Their discussion is reserved for another place, because they have to do mainly with activities outside the immediate working conditions now under consideration, and have only a general influence upon the health and *morale* of the working force of a plant. One aspect of the nutrition question however deserves consideration in connection with shop conditions; namely, that of facilities for getting and eating the noonday lunch.

Probably less progress has been made in this particular direction than in any other, even in those factories standing well to the front as



CARE FOR THE PHYSICAL WELL BEING OF THE OPERATIVES.

The stool used in the room shown in the upper view (lock and drill department, National Cash Register Co.) is very comfortable, though somewhat expensive and limited in application because of its fixed standard. Flat-top stools of simpler make are shown below (bottling department of the H. J. Heinz Co.) and suggest the possibility that the inspectors and sealers (at the left) might also be provided with seats.

exponents of altruistic principles applied to business. It is quite common to find arrangements in large industrial plants, and small ones too, for furnishing officers and foremen with the noonday lunch when such facilities are unsatisfactory or quite lacking in the vicinity. In a few notable instances dining or lunch rooms have also been provided for women employees of all classes. But there are a very few cases only where any attention has been paid to the problem of giving lunching conveniences to the ordinary workmen. Unless situated in the country, and frequently even then, the saloon with its free lunch and many doors facing every avenue of access to the factory, invites the hungry, thirsty, and usually dirty workman. For a small sum he gets his bucket of beer and a little spiced food, or gets the beer and eats a cold lunch, quite likely to be badly prepared and lacking nourishment. Under the prevailing conditions it is not surprising that so large a proportion of workingmen patronize the beer shop, to the disadvantage of their productive capacity the rest of the day. For it is a common testimony of foremen and others having to do with the supervision of workmen that the noonday patron of the saloon, and the "can rusher" where beer is permitted in the work shops, is likely to be drowsy and listless, and therefore working below his full capacity, the whole after part of the day. Usually the only alternative to patronizing the saloon and the curbstone is that of wiping a clean spot around the mouth with a bit of waste and eating with dirty or greasy hands a home-prepared lunch from a bench, or the nearest pile of material scattered about the floor. Aside from the quality of the food thus consumed, whether from the saloon, the curb, or the work bench, there remains to be considered something besides the inferior physical condition of the employees resulting from the use of foods so likely to be ill adapted and poorly prepared—namely, the attitude of workmen and workwomen toward an employer who thus insults their manhood and womanhood by expecting them to put themselves on so low a level. Many work people take such a condition as a matter of course, never having been accustomed to any other; but intelligent self-respecting workmen resent it, even though they may say nothing.

The justification for the so-called welfare institutions is twofold: the moral obligation of the employer to provide conditions of work that tend to the comfort, moral well-being, and self-respect of the employed; and the promotion of a cordial attitude on the part of the employee toward the employer. The saw often repeated among women that the way to a man's heart is through his stomach is generally applicable, in a measure. And though it may not in all cases

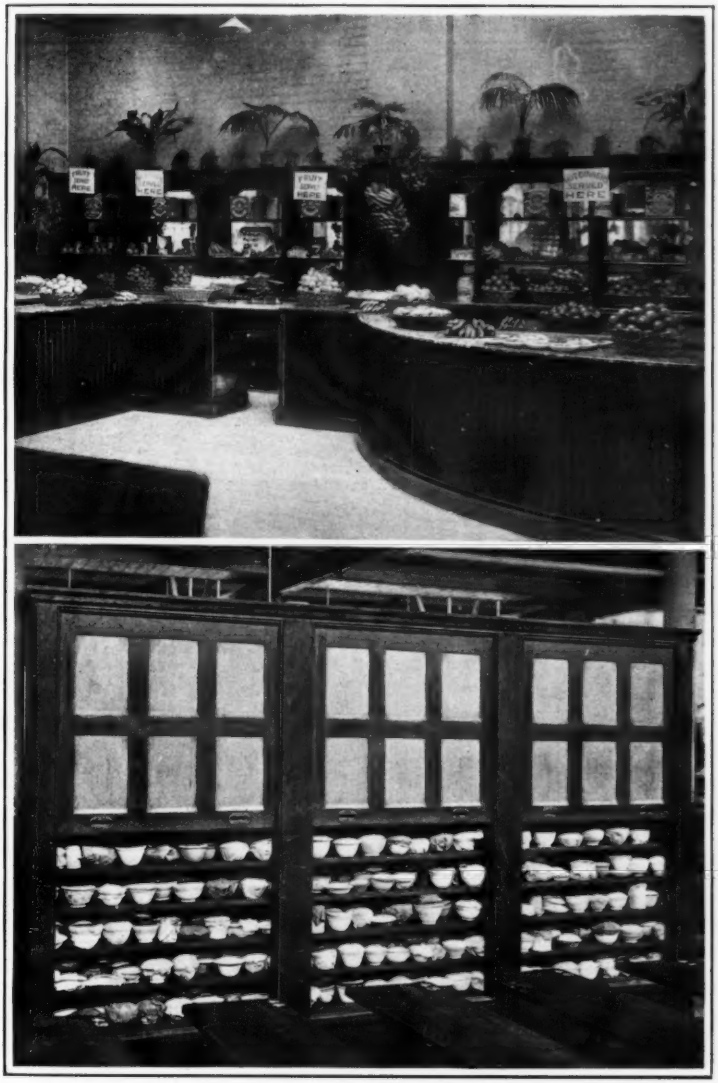
AN EASILY ARRANGED SHOP LUNCH ROOM.
Set in a space partitioned off from the working floor. Tables set on horses easily stored when "knocked down," and chairs also folding into small space. Acme White Lead & Color Works.

be expedient or desirable to furnish food, a genuine effort by the employer to give his people opportunity for decently eating a lunch, along with other facilities for observing the decencies, will go far toward promoting such a feeling.

It is not necessary, though often advantageous, to carry on a factory restaurant. Between such a course and that of do-nothing are several steps. The simplest thing that can be done, after providing facilities to wash hands and face, is to set aside a corner of the shop where tables and chairs are ready for use at lunch time. Since most shops are more or less dusty, it would be found troublesome to keep the tables fit for the purpose intended. For this reason and the further one of economy, it is better to have a small room partitioned off where the workmen from several adjacent shops, or in case of comparatively small plants, all the employees, may come together. Where the plant covers much ground and many floors, there ought to be several such places, enough to bring one of them into easy reach of every workman. The simpler the furniture, the more likely it is to be used. At one place tables with attached benches were made and set out of doors. These were used by many until they became filthy and fell into bad repair, no attention having been paid to them after they had been set out.

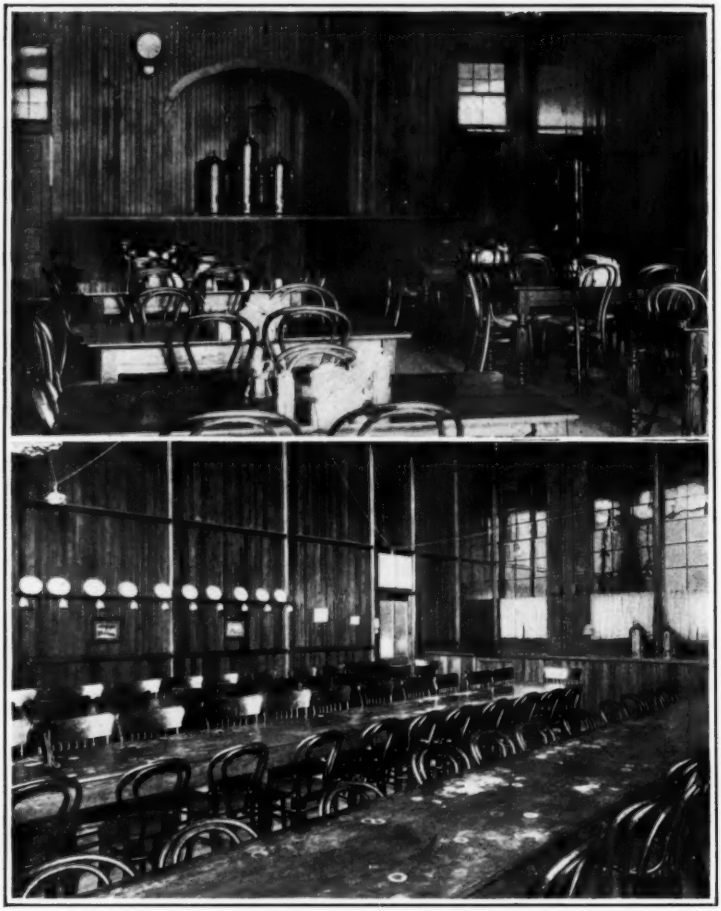
ANOTHER SIMPLE FACTORY LUNCH ROOM.
Sherwin-Williams Co., Cleveland, O.

A steam coil for heating coffee and warming



COMMISSARY INSTITUTIONS AT BOURNEVILLE.

The upper picture shows the fruit counters, over which fruit is sold to employees at a very low price during the lunch hour. The lower view illustrates the warmers, in which dinners brought from home by the work people are stored and warmed in time for lunch.



MIDDAY LUNCH INSTITUTIONS IN WELL-KNOWN SHOPS.

The upper picture is taken in the works of the Ludlow Mfg. Associates; "a coffee urn and a supply of cups is about all the equipment needed, apart from wash-sink, tables, and chairs." The lower view is in the McCormick malleable foundry—a corner cut off, with tables and facilities for securing coffee at 2 cents a cup, and for warming lunches in the near-by core ovens.

the food helps, and has been made a source of much satisfaction. In one case I know of the core-makers use the core ovens for warming up the lunches brought from home, and sometimes to roast potatoes or cook portions of other food. Steam tables and other devices are

sometimes provided for a similar purpose, and in at least one instance a rather elaborate system of warming closets has been designed for holding and heating home-prepared lunches.

A LARGE LUNCH ROOM CONVERTIBLE INTO AN AUDITORIUM.

A 15-cent lunch is served on the cafeteria plan. McCormick Works, National Harvester Co.

A favorite plan both with workmen and employers (where anything of the sort at all is undertaken) is an arrangement to sell good hot coffee, and sometimes other soft drinks, at a low price. Two cents a cup, it has been found, allows for a generous cup of such coffee with cream and sugar. In some places where this plan has been tried the coffee is sold for less, sometimes for a cent a cup. Not everybody buys, but many do. Neither do all the workmen make use of the tables at first, but many do; and in time, as experience has shown, practically all do so. Very few eat from a work bench or scrap pile by preference.

The hot coffee implies that there is to be an attendant for the lunch period and perhaps a short time before, if not for the entire day. In shops where there is a matron for the girls, there is no difficulty about this. A coffee urn and a supply of cups is about all the equipment required other than a wash sink. A little addition to the equipment by way of steam tables or ovens makes it possible to warm food brought from home: and a still further addition allows the preparation of such foods as soup, beans, and the like, which would be sold

AN OFFICERS' AND OFFICE EMPLOYEES' DINING ROOM.

L. C. Smith & Bro., new typewriter factory, Syracuse, N. Y.

in suitable portions, and consumed usually in addition to the food brought from home. The most satisfactory plan is to serve, from counters, after the "cafeteria" plan, a variety of dishes so that a full dinner may be selected. The prices must be small, but the service need not be at a loss. Some employers offer the food below cost and think themselves recompensed in other ways. Having the experience, they should know. In several instances coffee is furnished free of cost, and in others soup also. In still others a lunch is given to all required to work overtime.

The most important things to be considered in the conducting of such a lunch room or restaurant are three: first that the food must be of good quality and suitable quantity; second, the charge must be such as to bring it within the reach of every employee; and third, provision should be made for those who may choose to eat only what they bring from home. It is notoriously difficult to cater to all palates, under any circumstances; but a short experience will indicate what foods and what quantities are most satisfactory. The fixing of the price to be charged presents a peculiar difficulty aside from that involved in the cost of production and serving. Under average conditions the factory hand feels keenly, especially if there be a large family dependent upon him, every trifling expense, and therefore hesitates to buy a lunch when he is able to bring one of some kind from home. He will not spend even fifteen cents (a price at which a very satisfactory meal can be served) because he thinks he cannot afford to do so. The lunch room where is served only a full meal, or portions costing more than five cents or so, is little patronized by the men for whom such a place is primarily intended. This is an almost uniform experience in the management of factory restaurants and lunch rooms. The point is to set a price, if possible, at which the workman will feel that he can afford to buy one or more dishes and at the same time pay about what the same thing would cost if prepared at home. Factory men, as self-respecting workers, resent charity. Neither will they pay more for things, especially eatables, than the value to them. To meet this difficulty it may be necesssary under some conditions to sell the food at a price below the actual cost. This is most likely to be the case in small plants where experienced buying and the most expert mangement in the kitchen and dining room are not available. Where such buying and management are not out of the question, it is shown to be quite possible for a workingmen's lunch room to be self-sustaining and well patronized.

In a large factory it is necessary to consider also the question of

AN IMPROVISED LUNCH ROOM, OFFERING MUCH SUBSTANTIAL COMFORT WITH LITTLE OUTLAY.

Uses any vacant space on the factory floor. Tables and chairs are collapsible, and can be stored in small compass during working hours. Acme White Lead & Color Co., Detroit.

accommodating the men in the remote parts of the plant as well as those in the more accessible portions. The lunching room must be brought within their reach, physically as well as financially. There ought to be, under such circumstances, a number of lunch rooms pretty well distributed. If food be served in all of them, it would obviously be prepared at a central kitchen and distributed as required to the several places. By such an arrangement there would be no duplication of kitchen equipment; and production, being on a large scale, would be much more economical than if distributed among several kitchens.

The distribution of the prepared food presents no especial difficulty. It is readily accomplished by trucks designed for that purpose, and the use of steam tables and heaters at the dispensaries. It might be found advisable to serve food at part of the lunch rooms only; and perhaps no more than coffee, or coffee and soup, at others. The whole problem is very evidently one of local application, and must be worked out to meet the local conditions. It is equally evident that the problem is one to be worked out gradually. The simpler the be-

A LUNCH TRUCK IN USE IN A FACTORY.
Used in carrying coffee, warm dishes, and prepared food to the several shops and lunch rooms. Acme White Lead & Color Works, Detroit.

ginning, so long as it is an earnest of what is to follow, the more likelihood there is of ultimate success. The opening of a few rooms with tables and chairs has been mentioned as desirable in beginning. In one factory the men were first interested by the distribution of hot coffee to them at their work benches. The practice is still continued, under certain circumstances, though there are now several lunch rooms in operation in the plant. Another large factory almost by accident allowed a milk dealer to begin delivering bottled milk to certain of his customers while at work. Very quickly other workmen wished to buy, and in a short time the milkman was doing a flourishing business. It is a common sight at almost any hour of the day after the milk delivery has been made to see a workman refreshing himself with a drink from a white bottle and eating a slice of bread from the lunch box. The saloonkeepers of the neighborhood are unanimous in their condemnation of the practice, and it is asserted that because of it several have gone out of business.

Another innovation at the same place is the delivery of ten-cent prepared lunches by an outside concern. These lunches are put up in pasteboard boxes and are very satisfactory for the price, much better and probably more wholesome than most of the office men (who are the chief patrons of the lunch wagon) would be likely to bring from home.

Space is always at a premium in a manufacturing or trading plant, and very likely the first question asked, in considering the lunch room problem, is, where is the room to be found? Of course space is necessary; though probably not as much as might be thought. Room given to such use is not therefore nonproductive. A pleasant and neat room reserved for this purpose and perhaps also some sort of recreation yields rich interest in the education and good will of employees.

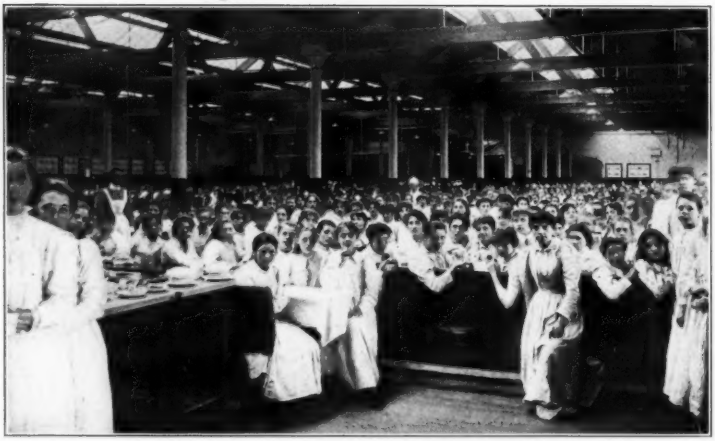
However that may be, it has been found that what might be called a convertible lunch room, used ordinarily for other purposes and at the proper time given over to tables and chairs, is quite feasible. An expedient that has worked well is that resorted to in one factory where table tops are hinged to the wall and swung out of the way when not in use as such. The chairs are suspended from hooks along the wall except at noon time. Another expedient available where wall space is wanting is that of swinging tables with attached benches from the shop ceiling by rope and tackle. Such an arrangement is very crude, but useful when nothing better can be done under the circumstances.

One other question that deserves serious consideration in connection with lunch rooms is the manner of serving the food. The counter plan so popular in the down-town restaurant has some advantages, including economy of space and convenience in serving. A few attendants can serve a great number of lunchers in a very short time. The disadvantages are well known to those that have patronized this sort of food dispensary.

The "cafeteria" plan, so called, in connection with suitable tables, is found to work admirably. Each diner takes from a counter such portions as he may wish, they being properly checked as he passes along. Economy of service is the chief consideration in this plan.

A MILK-DISTRIBUTING WAGON AT A LARGE ENGINEERING WORKS.

Maintained as a private enterprise by a reputable dealer, at no cost or inconvenience to the management, to the satisfaction of the men and the dissatisfaction of neighboring saloons. Deering and McCormick plants, International Harvester Co.



AN ECONOMICAL SPACE ARRANGEMENT OF A SHOP DINING ROOM FOR WORKING GIRLS.

Long, narrow tables and long benches make it possible to seat a great number of people in a given room. The illustration is from the Bourneville plant.

THE "COUNTER" PLAN OF LUNCH ROOM IN A LARGE ESTABLISHMENT.

It answers well the problem of economy in space and convenience in serving, but has disadvantages well known to all patronizing similar places. The view shows the men's dining room, Natural Food Conservatory, Niagara Falls, N. Y.

which is not often liked at first. The lunchers soon grow accustomed to the method, however, and patronize restaurants on this plan very freely. Unless this or the counter plan is adopted, the cost of service is an important item, the number of attendants necessarily being considerably greater.

When tables are used rather than counters, the arrangement of the former is of consequence. Of course it is more economical from space considerations to use long and narrow tables with chairs closely set. The disadvantage in such an arrangement is that it smacks a good deal of herding—something the men keenly resent. Furthermore, small tables permit the coming together of congenial groups and therefore a more free social spirit, which is one of the important considerations underlying the whole situation. Where it is possible, the use of many small tables, with room for four to eight persons, is greatly preferred. As to the table furnishings, not much can be said in a general way. Obviously this will depend much upon the class of work people catered to. Tablecloths and moderately fine dishes would be appreciated by a high class of women employees, and men as well; but the average shop man, who perhaps does not think it worth while to change coats or put one on and to clean up thoroughly before eating, would not go near such a table. Well cleaned table tops without covering, and very simple dishes, are usually to be preferred for shop lunch rooms.

THE SMALL TABLE HAS MANY ADVANTAGES, WHERE SPACE CAN BE AFFORDED.

The question of drinking water is closely related to that of lunch rooms, and in summer is of equally great importance. Astonishing as it may seem to a thoughtful observer, there are yet many factories where no provision whatever is made for quenching thirst—not even a water barrel. The lack of suitable provision in this matter is a serious inconvenience and not infrequently entails considerable suf-

INTERIOR OF GIRLS' DINING HALL, "PORT SUNLIGHT."
Factory of Lever Bros., Ltd.

fering. It may become a source of much evil and demoralization in a shop where the use of beer and other intoxicating beverages is not forbidden. The sight of a boy "rushing the can," carrying on a stick perhaps as many as a dozen buckets of beer at a time, is familiar about some shops. For moral and economical reasons whose validity is now pretty generally recognized, a good many employers permit no beer or liquor on the premises. Not all of them, however, provide anything better or even as good, and the employees are under the necessity of slaking their thirst with hydrant water, probably brought from some distance and too warm to be satisfying.

A system of supply pipes leading pure water to every shop and room in the factory, delivering it through a sanitary fountain, is, all things considered, the most economical method of handling the problem. If really pure water can be had in sufficient quantity to run freely and therefore remain comparatively cool, the result is satisfactory all round. Sanitary fountains, supplying the water in a small basin or from a goose-neck pipe so that no cup is used, are in any event desirable. This prevents possible contamination through the promiscuous use of the frequently dirty cup or dipper. A less sanitary and economical plan is that in vogue in a number of factories of placing barrels in convenient spots and keeping them filled with cool water.

A MODERN SANITARY DRINKING FOUNTAIN.

In such case ice can be used to advantage. A better arrangement is that of using ordinary water coolers, well distributed. A simple form of cooler is in use in some shops, consisting of a large wooden keg (or better, a stone jar) packed in a larger barrel. The space between is filled with sawdust. A very small quantity of ice serves to keep the water cool. In foundries and forge shops, or other places where the heat is uncomfortable, water alone does not give entire relief. A half pint of oatmeal or other form of crushed oats placed in the barrrel or cooler adds greatly to the thirst-quenching power of water. The flavor is not at first relished by some; but the taste for it is soon acquired, so that the beverage is used with much satisfaction. Where this drink is provided and generally used, it is very rare indeed that a prostration due to heat or excessive drinking occurs. Furthermore, it has the effect of reducing the desire for beer.

As the oatmeal sours in a day, it is necessary to clean and scald the tank or cooler, as well as the dipper or cups, thoroughly every day before a new supply is put in it. Faucets cannot well be used with the oatmeal water because the meal tends to clog them. Wooden spigots can be used if the oatmeal is put into muslin bags. This expedient also makes it easier to keep the coolers in a clean and sanitary condition. In some shops where the management has not taken up the matter, the workmen have made arrangements for a supply of water and ice, paying for the services themselves. There seems to be no good reason why the employer should not bear the expense; and the obviously increased efficiency and comfort of the men presents at least one good reason why he should do so.

PLASTER MINING AND PREPARATION IN THE VICINITY OF PARIS.

By Jacques Boyer.

It has been recently pointed out in this Magazine that the increasing production and use of cement is one of the significant phenomena in engineering construction. This movement reflects an interest upon the older industry of plaster mining and preparation, and M. Boyer describes the methods in use in the most notable plaster-producing region of the world.—THE EDITORS.

PLASTER is obtained by the calcination of gypsum, or sulphate of lime, which is found in vast beds in the neighborhood of Paris, and legend attributes its discovery to a shepherd of Montmartre. Cooking his food in an open-air fireplace, built in part of blocks of gypsum, he unwittingly manufactured plaster of Paris. A shower following wet the plaster, the dehydrated blocks of gypsum cementing together the adjoining stones, thus pointing the way to a discovery of the utmost usefulness to humanity.

Whatever may be the origin of the anecdote (and it is probably imaginative rather than authentic) it is certain that plaster was known to the ancients, as Aristotle and Pliny bear witness. It was employed first for making casts. It still serves the same purpose, throughout the world, the chief supplies being drawn from France; but gypsum is found also in America, England, Italy, Greece, and Germany. Its more important industrial use, perhaps, is found in building construction; the recent enormous increase in the use of concrete has been reflected in an enlarged demand for plaster, which is introduced into cement in large or smaller proportion to control the speed of setting.

In the basin of Paris, gypsum deposits are abundant under the hills on the right bank of the Marne, from Fère-en-Tardenois to the very heart of the capital; thence the bed skirts the margins of the Seine from Ivry to Suresnes. It then leaves the left bank of the river, to reappear on the right bank from Argenteuil to Meulan, reaching almost to Isle Adam in the valley of the Oise. The entire formation has roughly the form of an enormous lens, the thickness tapering gradually toward the borders.

The gypsum lies above a sandstone or grit, and is in three beds of which the lowest consists of alternating strata of gypsum and cal-

GENERAL VIEW OF GYPSUM WORKINGS NEAR PARIS. ENTRANCES TO THE MINED CHAMBERS.

careous and argillaceous marls, the former compact and the latter highly schistose. In the intermediate bed, the gypsum strata are more important, the marly layers are fewer, and fossil fishes occur; but the most interesting, from every point of view, is the uppermost bed—technically known as the "first" or "high" bed. It is heavier and richer than the others, attaining sometimes a thickness of twenty metres, and with very few intercalated marly strata; in some places it lies immediately under the tillable soil. It may be remarked, in passing, that it was in this bed that Cuvier found the remains of birds and mammals upon which he based his system of paleontology.

The Parisian plaster deposits are worked by open-air quarrying, by subterranean galleries, and by shafts, the most important workings being those of Romainville, Noisy-le-Sec, Montreuil, Bagneux, and Argenteuil.

Open-air quarrying is conducted by several methods, the first being that by "benches." The gypsum is first stripped of the overlying soil, and then the rock is removed, beginning at the top. The rock is thrown down by blasting, and as it is very soft, the shot holes are bored with an auger from two and one-half to five metres long. The designated depth being reached, enormous faces are blasted off, the gypsum being broken up after it has fallen.

OPEN QUARRYING OF GYPSUM-BEDS.

On the left, a workman is boring a hole with a long auger; the others are throwing down and breaking up the detached blocks, which are finally wheeled away in the little trams.

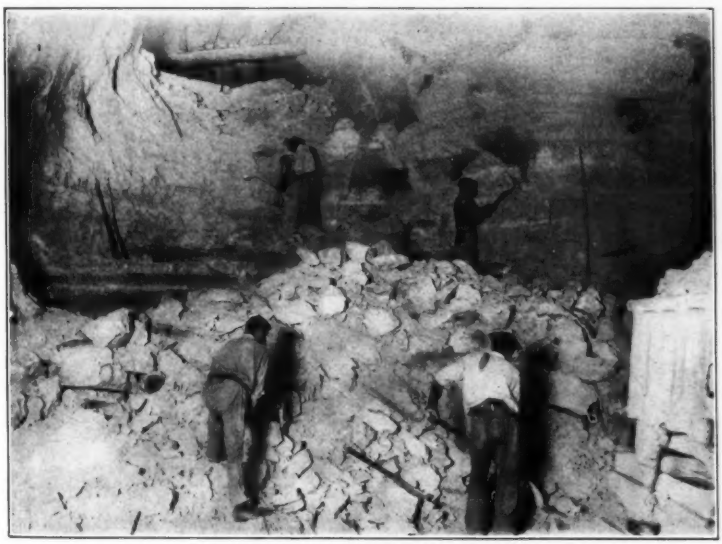
The second open-cut method is by undercutting, or "*chute.*" The highest stratum is stripped, and the marls separating it from the next lower layer are cut away, the overlying mass being supported meanwhile with the additonal aid of props called *chandelles.* Having undermined as large an area as it is proposed to drop at one time, shot holes are bored in the pillars which have been left to support the roof, and the charges are placed, care being taken to have the fuses of the front row shorter than those further back. The stulls are then removed, and the shots are fired. The short-fuse holes in the outer row, by their earlier explosion, facilitate the fall of the roof, as the second and third rows successively follow. In the plaster workings near Paris, 6,000 to 7,000 cubic metres are sometimes broken down thus at a single firing.

At Romainville (Seine) subterranean workings are carried on as shown in some of the accompanying photographs, taken at the quarries of M. Gauvain. The general view shows the tunnels or drifts, opening on the slope of the beds like a range of gigantic doorways. The walls of these adits are shaped obliquely upward to the form of a pointed arch, forming a natural roof which is further strengthened by heavy timbering.

The work of the miner is executed chiefly with the pick (called "s" by the laborers) and is the more trying because it often has to be carried on while the miner lies flat. In any case, the rock is broken down step by step, as in open-air quarrying, the miner working in as far as the length of his pick-handle permits, and then enlarging the under cut by small shots. He removes the débris, and continues his laborious excavation, working gradually upward until he reaches the roof. As the face is advanced, stulls are set and well capped with crossed timbers to support the roof pending the permanent timbering, for which oak is employed.

When this stage of the mining is completed, the *chandelles* or temporary timbers are removed, and the *coupeur* gang proceed to finish the work. They rob the pillars left as support for the roof, dressing down their faces with the pick and cutting them away from the working face of the chamber. When the excavation thus made is sufficiently enlarged, they bore auger holes for blasting to hasten the operations.

Shaft mining is applied chiefly to the working of the third or lower bed, and the hoisting of the mined blocks is still effected in the Parisian gypsum quarries by the most primitive means. At Romainville, for instance, the work is often done by a horse whim, operating



WORKING BY SUBTERRANEAN CHAMBERS.
Miners drifting with picks.

a winch which hoists a loaded skip; this is dumped by hand into small trams.

After the gypsum has been mined and broken into pieces, the next step is to calcine it to remove the water of crystallization, and thus transform it into plaster, which is further ground.

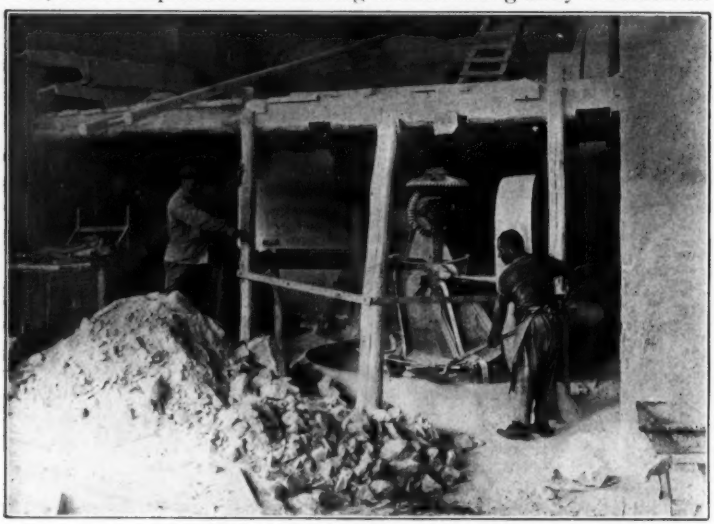
Roasting is accomplished at a temperature between 80 and 200

HOISTING MINED BLOCKS OF GYPSUM BY MEANS OF A WHIM.

ROASTING GYPSUM TO PRODUCE PLASTER OF PARIS.
Toward the close of the operation, sheet-iron plates are laid over the arches to check loss of heat by radiation.

degrees C. Above or below that, according to M. Henri Leclaire, the product obtained is inert, incapable of absorbing water or of setting when used in mason work. The roasting is effectively carried out under sheds protecting the piles from the rain, as shown in the illustrations. The "furnace" is built of the gypsum blocks themselves. At the base are placed the larger pieces, arranged in the form of

arches. Upon these is laid the fuel (wood, coal, or coke) and the structure is built up with smaller and smaller pieces, passages being left for the discharge of the smoke and vapor. Toward the close of the operation, which lasts about ten hours and treats some 500 cubic metres of rock at a time, sheet iron is placed over the arches to prevent loss of heat by radiation. Each roasting heap requires two attendants for the building and the management and drawing of the fires, and two operatives for hauling in and hauling away the material.



GRINDING THE ROASTED PLASTER.
A bucket conveyor carries the crushed material to a central screen.

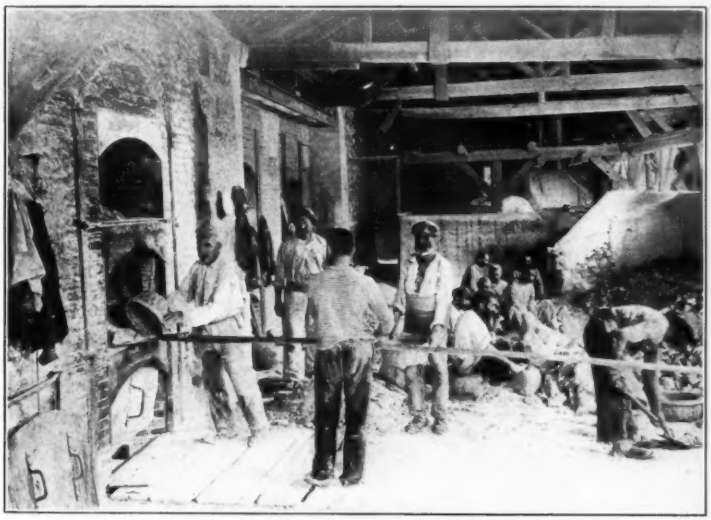
After roasting the pile is allowed to cool for five or six days, and then the rock is pulverized. A half-century ago, this crushing was accomplished by spreading the material on the ground and beating it with a tool called a *bedu*—whence the French expression "to beat like plaster." Nowadays this primitive process is replaced by the use of steel mills revolving in a circular trough with a perforated bottom. Some of these mills are equipped with bucket conveyors, carrying the ground material to a central screen of varying fineness. That part which is sufficiently ground drops through, and the remainder is returned to the bed of the mill. The plaster manufacturer can thus secure the degree of fineness of grinding demanded by his trade.

Plaster intended for statuary or architectural decorative purposes is made in similar fashion to that destined for constructive work, but

greater care is used in its preparation. The gypsum is first selected carefully, and then air-dried for some months. It is then broken into pieces by workmen with hammers. The roasting is effected by thrusting the fragments on a long spade into a furnace similar to a baker's oven. After it is roasted, the plaster is pulverized and screened through hair or silk bolting-cloth, according to the fineness desired.

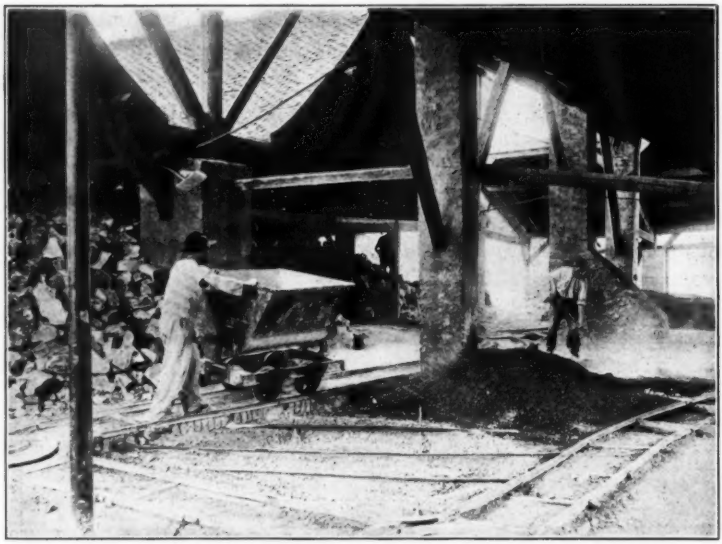
For stucco work, use is made either of ground plaster mixed with strong glue or of aluminated plaster, obtained by a second roasting with an admixture of alum. Skilful workmen can give to plaster thus prepared a beautiful polish, and by admixture of various metallic oxides can imitate all the shades of marble.

Ordinarily the pulverized plaster is carried up to and deposited on a second-story level, from which chutes lead down to the ground floor. There the workmen attach sacks to the mouths of these tubes, and by means of sliding gates in the chutes draw down enough to fill each sack in turn.



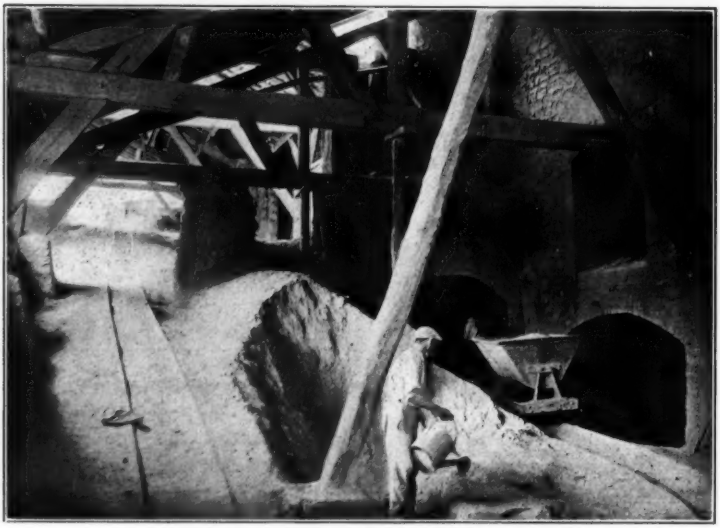
MAKING MOULDING PLASTER.
Breaking up and furnace-roasting the gypsum.

Apart from its use for building purposes, plaster is employed in ice making, in the manufacture of porcelain, and in the production of casts. It finds application in agriculture also, either crude as it comes from the quarry, partly dehydrated in special furnaces, or completely roasted as already described. Its fertilizing properties, first



TOP OF LIME KILNS.

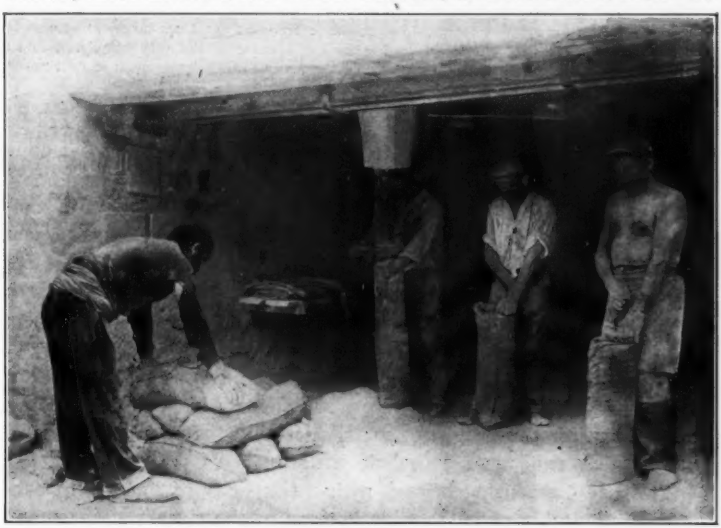
The nearer one is being charged; the further one (on the right) is burning.



SLACKING QUICK LIME.

noted by Meyer de Compterzel (1767), were brought into special prominence by Franklin.

At the present time the plaster workings in the environs of Paris, developed by some eighty companies, furnish annually 1,600,000 cubic metres and employ 5,500 workmen. In some of them are treated also calcareous marls which are found in connection with the gypsum strata. The decomposition of the carbonate of lime is effected in furnaces or kilns, built of masonry; the two illustrations shown, taken at the works of M. Gauvain, at Romainville, show the



SACKING THE FINISHED PLASTER.

general arrangement. The kilns are lined with firebrick, as the limestone must be heated to redness for many hours. When the burning is complete, the fire must be extinguished to draw the charge, if the process is intermittent. Nowadays, however, the intermittent working is generally giving place to continuous kilns, having a special opening permitting the withdrawal of the charge. As the furnace is emptied from below, it is correspondingly filled again at the top.

As it comes from the kiln, the quick-lime has a high affinity for water. It is sprinkled to convert it to slacked lime, which breaks up and falls into powder. In this state it is delivered to manufacturers, chemical works, and agriculturists, by whom in France it is consumed in large quantities.

THE ELIZABETH EYE-BAR SUSPENSION BRIDGE AT BUDAPEST.

By L. Ramakers.

The author indicates clearly in his opening paragraph the interest which attaches to the Elizabeth bridge as a completed example of the style proposed for much larger structures in and about New York City. It is interesting further because of the very large part in its construction played by distinctively mechanical processes, and of the great consideration given to aesthetic elements in the design.—THE EDITORS.

THE new "Elizabeth" suspension bridge at Budapest, as will be seen at once from the accompanying illustrations, has a double interest; first, in that it witnesses the return to favor of the suspension type, and second, in that it is almost identical in conception with ex-Commissioner Lindenthal's project for the new East River bridge to be built by the city of New York. The distinctive feature of that was to have been the eye-bar chains, but although warmly approved by the Municipal Art Commisssion, the plans were rejected for various reasons more or less well grounded. At all events, the construction of the Budapest bridge has demonstrated that the eye-bar chain is not only amply satisfactory in point of strength and rigidity for the weight of metal used, but that further it puts a true artistic stamp upon the whole structure.

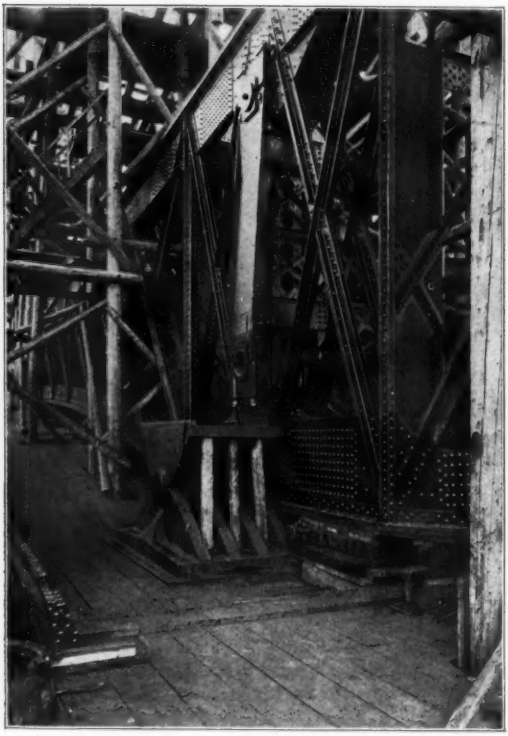
This new suspension bridge, with a simplicity of line which harmonizes admirably with the wide horizon of the river and the town, spans the Danube with a center opening of 290 metres and shore spans of 44.3 metres each. It completes a series of artistic structures designed, as the need has gradually increased, to accommodate the traffic between the two cities composing the Hungarian capital. Six permanent bridges (including the Elizabeth) now stand within the limits of Budapest; two of them carry railways, above and below the town. Three others are projected, and one of these is already planned. At present, within a distance of 2,500 metres, one may see four important bridges—the Marguerite, built in 1876 and enlarged in 1899; the first suspension bridge, built by the English engineer Clark in 1840-1849; the Francis-Joseph bridge, finished in 1896; and lastly, between these two latter, the Elizabeth bridge (Erzsébet-hid), of which this short description is given from notes supplied by M.

THE ELIZABETH EYE-BAR SUSPENSION BRIDGE, BUDAPEST.

Czekelius, the engineer under whose direction it was planned by the bridge department of the Hungarian Ministry of Commerce.

Of all modern Hungarian bridges the Elizabeth is most important, whether for general dimensions or for the length of the principal span. The designers could readily have increased this length, if they had not elected rather to be controlled by æsthetic considerations. The panorama of the Danube at this point is magnificent. The two immediately neighboring bridges—the old suspension structure (Lancz-hid) and the Francis-Joseph of cantilever type—present almost the same general aspect. It was desired this time to vary the proportions slightly, in order to avoid the monotony which would be created by a series of structures all exhibiting the same controlling lines. The piers are brought very close to the banks of the river, and the shore spans placed just above the quais, so that the entire width of the stream appears to be bridged by the single central span.

The architectural elements of the design are the work of M. Nagy, who had charge of the same features in the Francis-Joseph bridge. All the materials entering into the structure are of Hungarian manufacture, so that the complete work is regarded by the nation as synthe-



THE HINGED SYSTEM OF THE STIFFENING TRUSS OF THE ROADWAY.

sizing the states of development reached by the engineering profession and the structural industry in their country within the past few years.

The Elizabeth bridge carries a roadway, with footwalks on both sides. The rigid floor is composed of two continuous principal trusses, of which the upper chords form a continuous arc throughout the entire length of the structure, while the lower chords form arcs of different curvatures in the central and side spans. It is suspended from chains carried over steel towers, hinged at their bases upon rollers carrying the load to masonry foundations. The stiffening truss rests upon hinged struts at the towers and at its extremities on the masonry abutments.

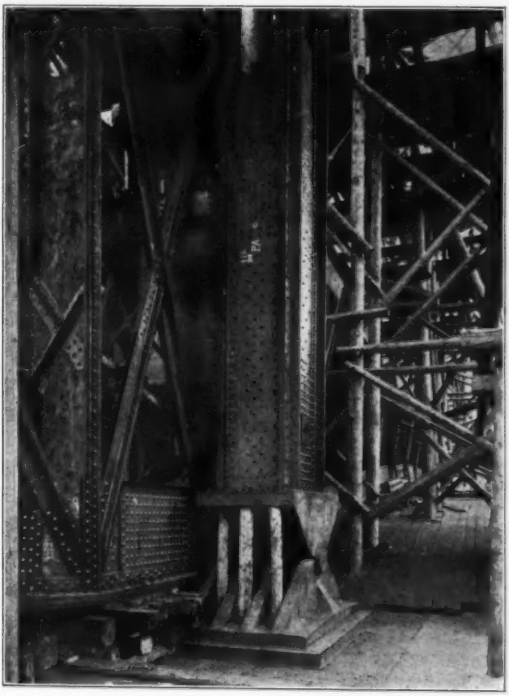
There are two eye-bar chains on each side of the bridge, superposed and about 1.50 metres apart. The suspender rods are fixed alternately to the upper and the lower chain. The ends of both chains are anchored in massive masonry; their highest points are 50 and 51.5 metres respectively above low water, and the depth of the catenary is one-tenth of the span. The two side spans are so short that it was not thought advantageous to suspend them from the chains.

The two piers forming each tower are connected together by cross-

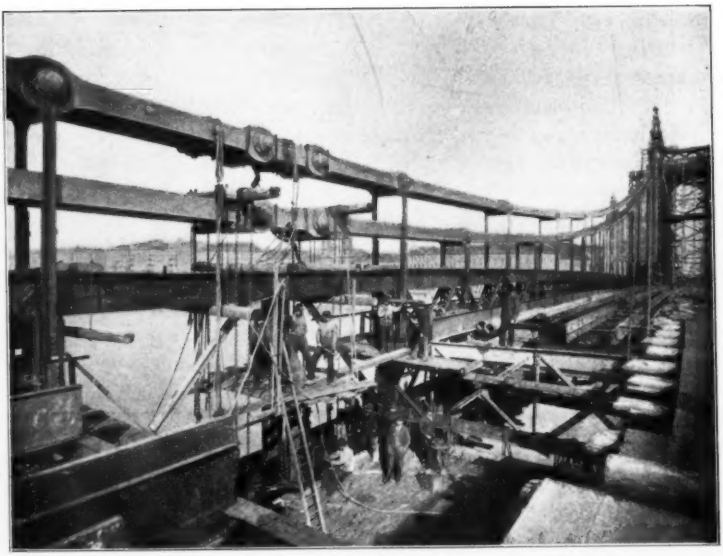
bracing and treated architecturally as decorative portals. The steel rollers, two under each pier, carry a load of about 7,000 tons (metric); they are 30 centimetres in diameter, each supported in two cast-steel pillow blocks weighing 15,500 kilogrammes each.

The floor is 20 metres wide betwen centers of the chains and of the principal trusses—18 metres inside the guard rails. The chords of these trusses are U-shaped, the upper one parallel to the roadway and 1.25 metres above it. To the passing traveller on the roadway or footwalk, therefore, the view is unobstructed save by the suspender rods, which are spaced generally 6 metres apart. The footways are built of corrugated steel covered with asphalt, and are 3.60 metres wide; they are supported on light girders. These, as well as the stringers of the carriageway, are carried on lattice girders resting on the principal trusses and diagonally braced. The whole bridge is strongly braced and stiffened throughout, with the aim of offering ample resistance to lateral strain.

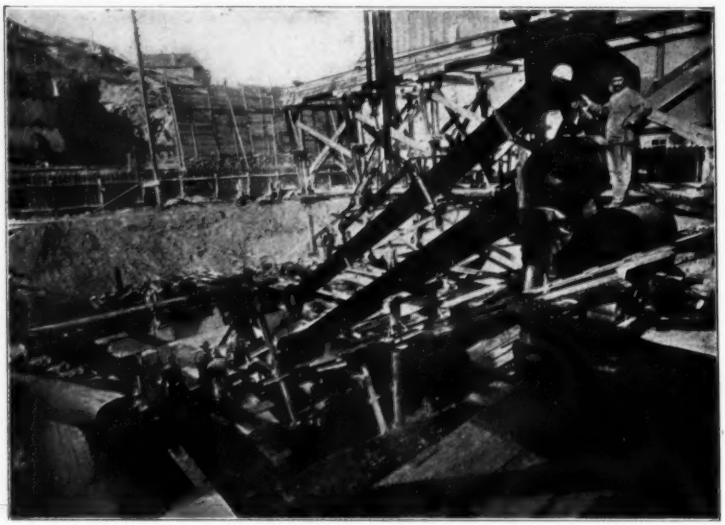
The pull of the chains upon the anchorage masonry—calculated at 6,600 tons—is distributed upon anchorage sole plates of ribbed cast steel, weighing 6,750 kilogrammes each, which themselves bear against a bedding of hard stone. The two chains in each anchorage are tied together and held parallel at the spring by



THE HINGED BASE OF ONE OF THE TOWER PIERS.



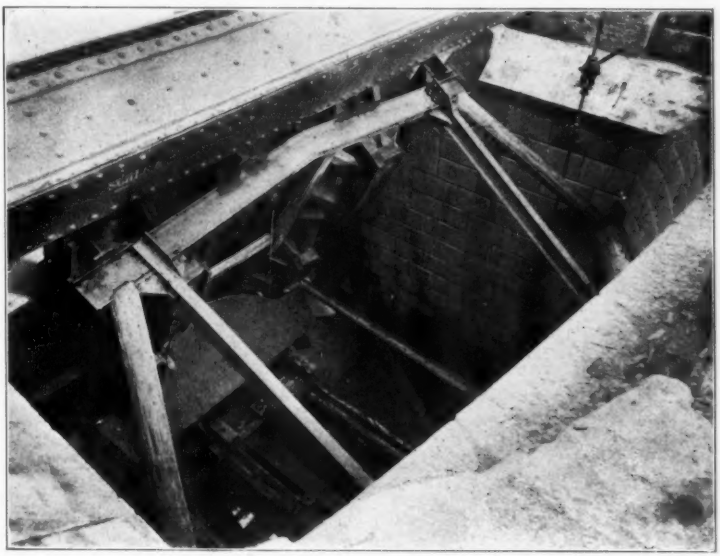
THE EYE-BAR CHAINS COMPLETE, AND CONSTRUCTION OF THE FLOOR UNDER WAY.



ASSEMBLING THE EYE-BAR LINKS IMMEDIATELY ABOVE ONE OF THE ANCHORAGES.

cross braces. Permanent access to the ends of the chains is provided, so that their preservation may be observed. Above these chambers are situated the offices of the *octroi*.

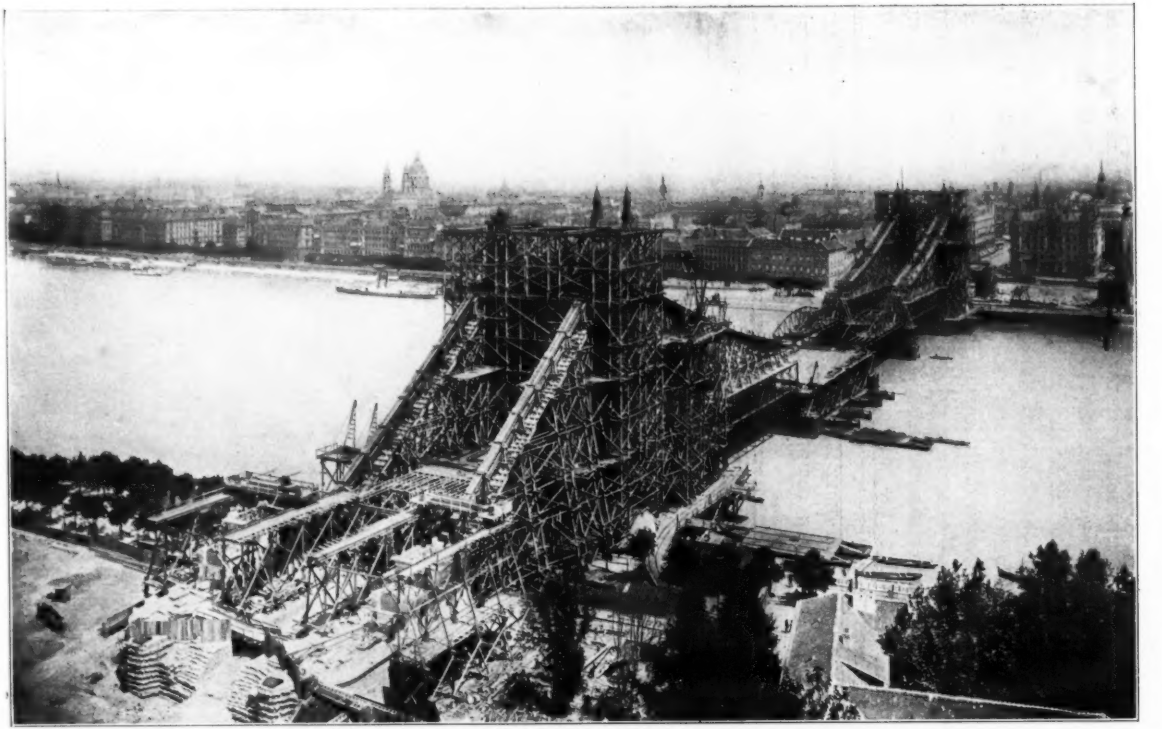
The eye-bars are made of steel plate, 15 to 25 millimetres thick, 40 to 90 centimetres wide, and assembled in parallel groups of 19 or 20 to form a section of the chain. The length of these sections varies, being in the case of some as great as 15 metres, but diminishing from the ends of the chain towards the middle. At the center of the long span the width of the body of the links is 40 centimetres and that of the head 72 centimetres. The suspenders are fastened at the joints of the chain, and hung from the same pins which connect the links. The entire system comprises 200 sections, weighing 4,270 metric tons.



THE ANCHORED END OF THE EYE-BAR CHAIN.

View looking into the permanent chamber left in the anchorage masonry, for inspection of the steel sole plate and the ends of the links.

The machining of these steel plates, of considerable size, and the necessity of the exact adjustment of each one to its position, imposed difficulties which were very happily surmounted. Instead of forging up, at each end of the plate or bar, the mass of metal necessary for the dimensions of the head, and then boring the eyes (as is frequently done in American shops), it was thought preferable to cut each link



THE EYE-BAR CHAINS APPROACHING COMPLETION, SHOWING THE ELABORATE SYSTEM OF FALSEWORK.

from a rectangular piece larger than the template. The loss of metal, it is true, was 40 per cent, but the gain was accuracy of work and greater certainty as to the tensile strength. The diagram shows the successive steps in the operation.

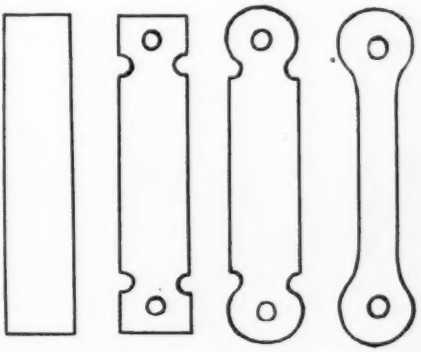


DIAGRAM ILLUSTRATING SUCCESSIVE STEPS IN THE MAKING OF A SINGLE EYE-BAR.

The mild steel used had a tensile strength of 55 kilogrammes per square millimetre (78,270 pounds per square inch) and a minimum elongation of 20 per cent. In the manufacture of the eye-bar links, the removal of metal was effected entirely by cutting, carefully avoiding any punching or shearing with the attendant necessity of an annealing which would have caused uncertainty as to the metal's retention of its original qualities. The planing, boring, and reaming machines used for the work were specially designed.

As each section of the chain required the assemblage of 38 to 40 links on a single axis, each link had to be rigorously accurate in its dimensions. In furtherance of this requirement, and to reduce to a minimum errors due to variation of temperature, all templates and gauges used on the job were made from the same steel as the eye-bars, and so far as possible, under similar conditions.

Particular care was used to avoid deformation of the links during handling in the shop or transportation between operations. The handling was accomplished by the aid of long girders, with holding clamps, supporting each piece uniformly throughout its whole length.

The removal of the metal from each blank, in the preparation of the single links, was effected by a pair of machines, working simultaneously on the two ends, cutting away a shoulder behind the head and boring the eye at the same time. A double-headed planer then cut away the remaining excess width along the body of the link; the several links of a section were assembled temporarily, and the finish-boring of all the holes of a single axis was accomplished at one operation. The diameter of these eyes varied from 30 to 50 centimetres.

The axes or pins, of varying diameter corresponding to that of the eyes, were forged from steel similar to that used in the links. Their

THE PANORAMA OF THE DANUBE AT BUDAPEST.

The Elizabeth Bridge is in the foreground, and the old suspension bridge next beyond.

length depended upon their position in the chain. The nuts were of cast steel.

The total length of the upper chain, comprising 4,094 eye-bars, is 525.5 metres. The manufacture of the elements alone required 21 months, covering 571,000 working days of 10 hours each. This manufacture was carried on, after data fixed by the National department of bridges, in a specially constructed workshop in Hungary. In spite of the great expense (710 francs per ton of chain) necessitated by the precise methods followed, the possibility which they presented of building up both chains simultaneously, at a point remote from the bridge itself but at the same time that construction of the piers and approaches was going on, was considered sufficient reason for preferring the chain to the wire-cable type. This advantage was especially marked here, seeing that the bridge was of large dimensions, that it was desirable to hasten its completion, and that the immediate neighborhood was much encumbered. The building up in place of cables of equal strength would of itself have presented great difficulties.

Foundations and Abutments.—The excavation for the foundations was commenced, with the aid of compressed air, in 1899, and carried to a depth of 9.10 metres below datum on the Pest side and of 5.50 metres on the opposite bank. Two caissons 19 by 9 metres were used for sinking each pier. The abutments were more difficult of construction on account of the critical importance of the anchorage foundations; it was determined to place these upon concrete beds, capped with asphalt, and laid continuously at each bridge approach

THE PANORAMA OF THE DANUBE AT BUDAPEST.

Completing the view on the opposite page. The Francis-Joseph Bridge is in the foreground.

so as to avoid cracks. The work was done within a sheet-piling enclosure re-enforced with metallic braces. Inflows of water impeded the work at various points until the channels in the sub-soil by which they gained entrance were successfully concreted. The plan adopted, as we shall see further on, involved certain dangers due to the character of the sub-soil, and these eventually became evident.

Outside of the concrete portion, the masonry is of granite. The parts beneath and around the anchorage chambers were first constructed; then the anchorage sole-plates were placed in position and blocked up on temporary supports while the masonry was built up to them. The stonework was carried forward progressively as the lower portions of the chain were assembled in place. To maintain the links or eye-bars of the lowest section at their proper distance apart, "washers" or blanks of proper form were introduced.

The erection of the bridge did not begin until the spring of 1902; it was effected with the aid of huge scaffoldings, which left, in the width of the river, four openings of about 50 metres each. The false work was taken down at the beginning of winter, as there was danger of its being carried away by ice in the heavy current running at that season. The chains were already in place, and the work was continued without interruption, using them as support and building out the floor from both banks.

The erection had been in progress for some time when there became apparent, at one end of the bridge, a slight but discernible sliding of the anchorage foundation. It was discovered that the asphalt cap of the concrete foundation, raised to a high temperature

WORK ON THE ANCHORAGE, AND THE SHORT SHORE-SPAN APPROACHES.

by subterranean flow from hot springs, was the cause of this movement. In addition to temporary measures for supporting and lightening the suspended structure, a supplementary foundation was placed in front of the threatened one, and bonded into it and into the ground with heavy buttresses which held the whole together. Further, pig-iron ballast and foundations for the bases of statues not yet installed added their weight to that of the main foundation, to oppose any possible tilting upon the toe under the pull of the chains.

Tests under load did not show any further movement. On the other hand, a temperature rise of 10 degrees caused the floor of the bridge to drop 83 millimetres at the middle of the span. The oscillatory movement of the towers under the extreme range of temperature experienced are inconsiderable—only 2 or 3 centimetres.

The total weight of metal in the bridge is 11,170 tons, or nearly 30 tons (metric) per metre of length.

A QUARTER-CENTURY OF ELECTRIC RAILROADING.

By Franz Koester.

In our preceding issue, Dr. Bell discussed most instructively the latest development in electric traction—the application of single-phase alternating current. In this connection it may be of value to run over, in brief survey, the successive steps of the wonderfully rapid progress made in perfecting the electric railway and adapting it to a most important service in the economy of modern life.—THE EDITORS.

TWENTY-FIVE years only have elapsed since the introduction of electric railroading, but during this time enormous progress has been made in this branch of engineering. The greatest development in this field however has taken place within the Twentieth Century. This may be due to a large extent to the fact that railroad engineers did not sufficiently realize the benefits to be derived from this system, and hence the development devolved almost entirely upon the electrical engineers.

Electric railroading, during the first two decades of its existence, was carried on in such limited fields that the system was either the ordinary direct current, or storage battery mounted on the cars. During the latter part of the nineties the combined alternating- and direct-current system appeared, while in the last five years the three-phase alternating was successfully introduced; and, finally, the marked progress of the single-phase system has developed only in the last two years. All these systems have been employed under various conditions, with more or less success, both for city and interurban freight and passenger service. Each system has its own advantages and supporters.

The first electrically drawn train was put in operation at the Berlin Exposition in 1879, (Figure 1) as constructed by the Siemens and Halske Co. of Berlin. This, however, was only a miniature model, while the first practical, commercial electric railway was that in Lichterfelde, near Berlin, put in operation, (also by the Siemens Co.) in 1881. Therefore the honor of the first commercial electric railroad belongs to Germany.

This road was 2.5 kilometres long, had a gauge of one metre, and operated at a potential of 160 volts delivered through the rails. The

FIG. I. THE FIRST PUBLIC UNDERTAKING IN ELECTRIC TRACTION. BERLIN, 1879.

FIG. 2. ONE OF THE LATEST ELECTRIC LOCOMOTIVES. NEW EQUIPMENT OF THE NEW YORK CENTRAL RAILWAY.
Built by the General Electric Co., Schenectady, N. Y.

rolling stock consisted of three motor cars (Figure 3), each equipped with a single ten-horse-power motor. Each car had a capacity for ten passengers. Two years later, in 1883, the installation of the road between Mödling and Hinterbrühl near Vienna followed. This road was 6 kilometres long and had the same gauge as the former, but instead of conducting the current through the rails an overhead system was adopted, consisting of two slotted pipes, supported by catenary suspension, similar to the present practice in single-phase railroading, (Figure 4). Current was taken by means of carriages

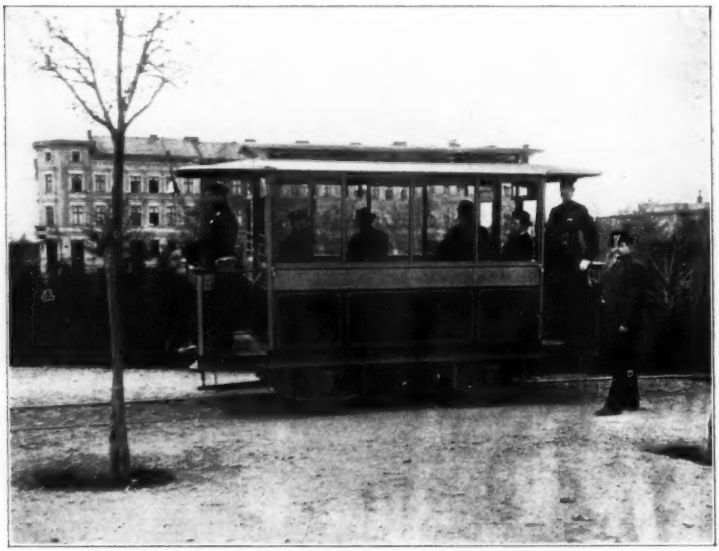


FIG. 3. AN EARLY COMMERCIAL ELECTRIC RAILWAY; LICHTERFELDE, NEAR BERLIN, 1881.

drawn along these pipes by flexible couplings. This was soon followed in the same year by the installation of the Portrush road, of the Giants Causeway and Portrush Tramway Co., operating on the third-rail system, and also by various other equipments.

After having operated several experimental electric roads in America, the first commercial road was installed in 1886 near Baltimore (Figure 5).

As time elapsed various roads were built, up to the year 1889, when in the city of Budapest the first underground-trolley system was installed. This system was so designed that the slot formed part of one of the running rails, as in the later built roads of Berlin and

other European cities. This road (still in operation) was twenty miles in length, partly overhead and partly underground construction. The underground sections were adopted, in spite of the excessive cost, on account of the desirability of not disfiguring the more prominent part of the city with overhead wires; thus the equipment of the cars with both underground shoes and overhead-trolley poles was necessary.

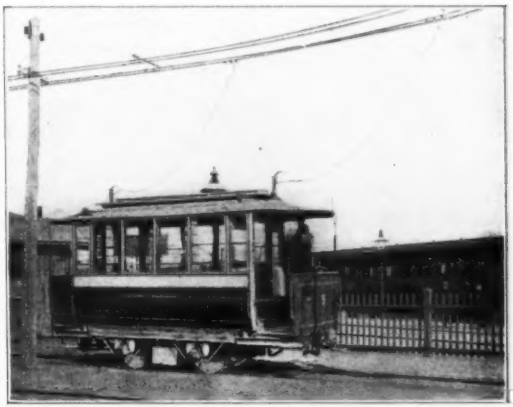


FIG. 4. ONE OF THE FIRST OVERHEAD TROLLEY CARS. Mödling, near Vienna.

In the year 1890 the first underground electric road, (subway) some six miles long, was put in operation in London, England. The rolling stock consisted of fifty-two locomotives (Figure 6), each provided with two motors supplied with current at a potential of 500 volts, by means of a third rail. Up to 1900 many prominent electric railroads were installed, the details of which however are without the province of this article. The greatest step in electric railroading was taken with the introduction of the alternating current, practically at the beginning of this century, thus making

FIG. 5. A PIONEER COMMERCIAL ELECTRIC RAILWAY OF AMERICA, BALTIMORE, 1886.

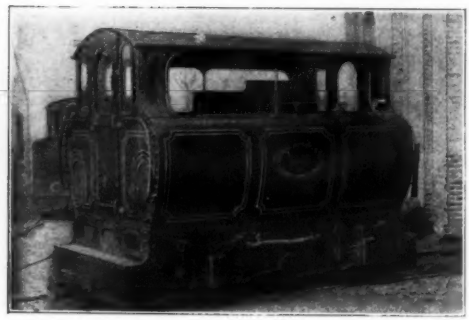


FIG. 6. ELECTRIC LOCOMOTIVE OF THE LONDON SUBWAY, 1890.
Siemens Bros. & Co.

feasible long-distance transmission. The first type of this system (as with the many still in use) consisted of a main central station where the alternating current is generated, and rotary-converter substations, transforming the current for use with the direct-current railway motors. Many such roads have been erected on both sides of the Atlantic and operate in city districts as well as under interurban service.

Under this class might be mentioned, the newly installed New York Subway, the great municipal railway system of Vienna—where in the entire city no horse car at present exists—and the Berlin Elevated and Underground Road; a number of prominent steam roads

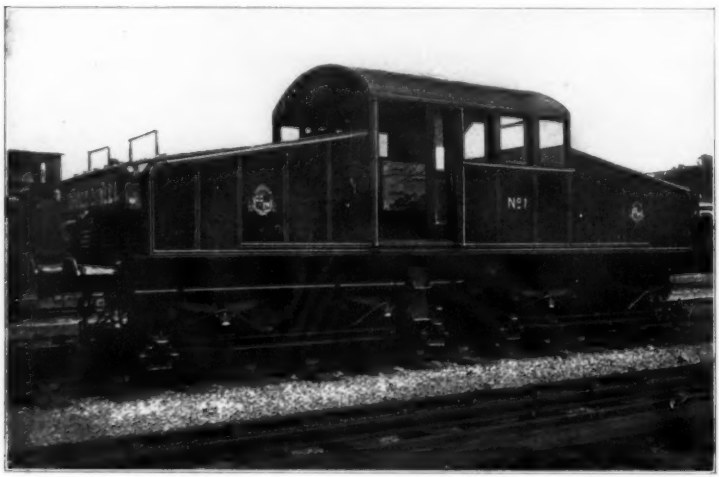


FIG. 7. ONE OF THE 150-TON ELECTRIC LOCOMOTIVES FOR THE LONDON METROPOLITAN RAILWAY.
Built by the British Westinghouse Co.

also have been thus electrified, such as the Chicago and Manhattan Elevated Roads, and (now under course of construction) a part of the Great Western Railroad near London (Figure 7), part of the New York Central and Hudson River Railroad (Figure 2), and part of the Pennsylvania. The locomotive represented in Figure 7 is equipped with four 200-horse-power motors which may develop an aggregate of 1,000 horse-power. This locomotive is capable of hauling a passenger train of 170 tons at a speed of 36 miles per hour while freight trains of 250 tons may be run at 27 miles.

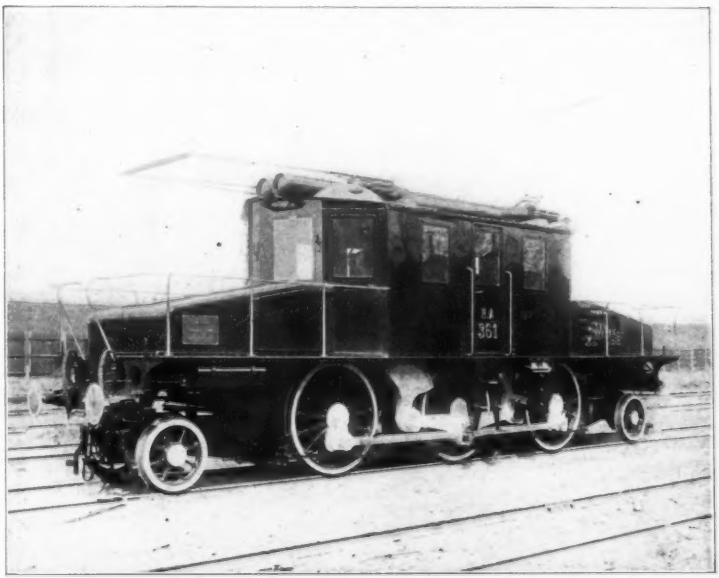


FIG. 8. NEW ELECTRIC RAILWAY LOCOMOTIVE OF THE VALTELLINA ROAD, ITALY.
Built by Ganz & Co., Budapest.

More prominent, and undoubtedly involving greater engineering skill, is the Valtellina Road of Italy, sixty miles in length, equipped by Ganz and Co. of Budapest, with their three-phase alternating system. Although this road and the system have been fully described in the technical press on both sides of the Atlantic, an illustration of the new type of locomotive as put in operation in 1905 will be of interest. This locomotive differs from the original type furnished with the equipment of the road some four years ago, in the arrangement of the motors with respect to the drivers. In the older type of

FIG. 9. SPEED TEST BETWEEN ELECTRIC AND STEAM LOCOMOTIVES ON THE NEW YORK CENTRAL RAILWAY.

locomotive the motors were mounted on hollow shafts surrounding the axles of the four pairs of drivers, the latter being connected to the rotors by means of links; while in the new type the motors are arranged between the three pairs of drivers, each motor axle bearing a combined high-and low-tension motor which before were spread over two driver axles. The system of connecting rods is clearly shown in the accompanying illustration (Figure 8).

Among other lines using the three-phase system may be mentioned the Jungfrau Railway, still under course of construction. On account of the magnitude of the undertaking this line is being built in sections and trains are operated over that part which is completed—at the present writing, up to the Eismeer Station. It will be some time before the peak, 13,665 feet above sea level, is reached. Locomotives of both the Oerlikon and Brown-Boveri type are used on this two-wire overhead system, the rail acting as the third conductor.

Another Swiss three-phase railroad will be put in operation, probably in the early part of this spring. It is that of the Simplon Tunnel, being the longest of its kind in the world. The system is that of the Ganz company, 15 cycles, 3,000 volts at the trolley wire. Another Ganz three-phase system is still under course of construction in Canada, between London and Port Stanley, a distance of about 27 miles.

Among the continuous-current roads, generally operating at a low potential, the 1,200-volt road in the coal-mine district of La Mure, in Southern France, is worthy of note. The locomotives are equipped with four 150-horse-power motors, a sliding bow being provided for each, taking current from one of the two overhead trolleys. This road was installed by the Compagnie de l'Industrie Electrique et Mécanique, well-known on account of various experiments with high-tension continuous current.

The newest addition in electric railroading is the introduction of the single-phase system, simultaneously in America and Europe, although on the Continent the roads were actually in operation several months earlier. For example there are the Murnau-Oberammergau Road connecting the Bavaria State Railway with the village of Oberammergau, world-renowned for its passion play. This road was, in 1904, some 14 miles long, operating at a potential of 5,500 volts and 17 cycles. The cars are equipped with two 80-horse-power motors. For carrying the overhead trolleys, span wires mounted on insulators are used, except that for a length of about one mile the catenary sys-

tem is installed. The equipment is by the Siemens-Schuckert Co. of Nuremberg. Another line frequently mentioned in the technical press is that in Spindlersfeld, near Berlin, which was actually an experimental line some 2½ miles long, installed and operated by the

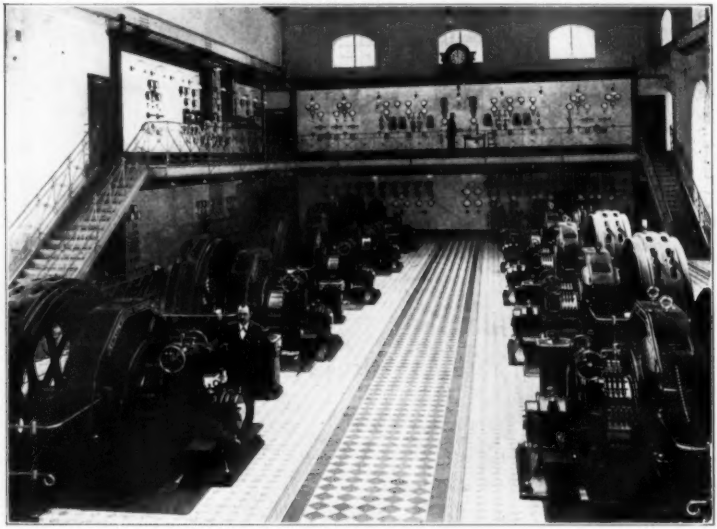


FIG. 10. A TYPICAL MODERN CONTINENTAL STREET RAILWAY SUB-STATION, VIENNA RAILWAY SYSTEM.

Allgemeine Electricitäts Gesellschaft of Berlin. The trolley is fed at a potential of 6,600 volts at 25 cycles. The cars are equipped with two 110-horse-power Winter-Eichberg motors. As this road has, since 1903, been operated as an experimental line, much valuable knowledge has been obtained from it.

Another most important road is that of the Stubaithal in the Tyrolean Alps, running from the capital Innsbruck to the resort Fulpmes, some eleven miles, put in operation by the Allgemeine Electrictäts Gesellschaft in 1904. The trolley voltage is 2,700, at a frequency of 42 cycles per second. These cars are equipped with four 40-horse-power Winter-Eichberg motors. Another road is the Borinage-Vicinaux in Belgium, near Mons, a line some 8½ miles in length, operating at a potential of 600 volts, 40 cycles. Another very important single-phase road is that between Rome and Pont Milvio, Italy, 33 miles long, installed by the Westinghouse Company. For a length of 2½ miles the trolley electromotive force is 550 volts, while for

most of the remaining part it is 6,600 volts, impressed directly upon the trolley wire. By means of main transformers mounted on the cars the current is stepped down to 250 volts for which the motors are wound. Another road is that of Baden and Vienna, some 15 miles long, installed by the Siemens-Schuckert Co. A very interesting single-phase railway system development is that of the Oerlikon Company, a notable feature of which is the use of the Huber current-collecting device.

The single-phase system, although extremely new, has shown very marked progress which naturally must be due to many advantages, one of the very important ones being the elimination of rotary sub-stations. The expense of the alternating-direct-current sub-station may be judged from the accompanying illustration. Figure 10 repre-

FIG. 11. A TYPICAL MODERN AMERICAN STREET RAILWAY SUB-STATION.
Philadelphia Rapid-Transit Co., 52nd St. and Lancaster Ave.

sents the sub-station Mariahilf of the Vienna Railway System, as designed and installed by the Siemens-Schuckert Co., while Figure 11 shows a sub-station of the Philadelphia Rapid Transit Co. Railway System, as installed by the Westinghouse Electric and Manufacturing

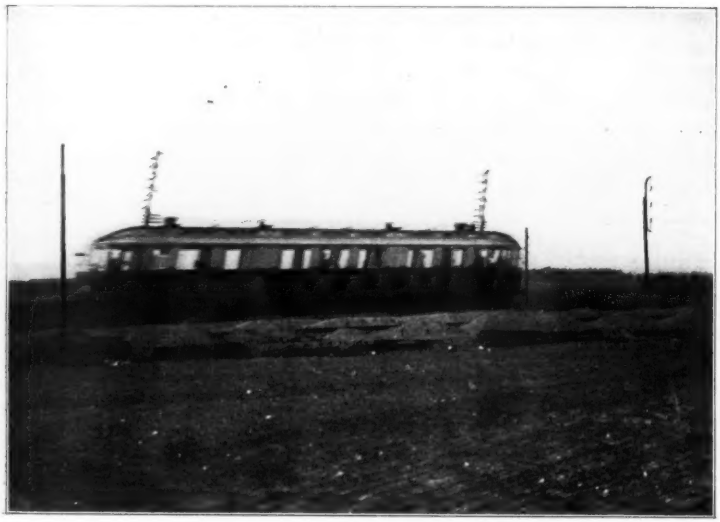


FIG. 12. ELECTRIC CAR MAKING 125 MILES AN HOUR.

In the tests of Siemens-Halske equipment on the Marienfeld-Zossen Line. The deformation of the image shows the motion during the very brief opening of the shutter.

Co. Both illustrations represent typical modern railway sub-stations of their respective countries.

The magnitude of the advancement during the life of electric railroading (twenty-five years) is probably best realized by comparing the first cars put in operation with the photographs made at recent high-speed tests. In Figure 12 we have the Siemens-Halske car running at a speed of 125 miles per hour. As every reader will well remember, the highest speed was obtained in the tests of 1903, 131.4 miles per hour, on the Marienfeld-Zossen road near Berlin. Figure 9 represents the General Electric Co.'s electric locomotive in a competition test with a N. Y. C. & H. R. R. Co. steam locomotive, both drawing trains made up of six cars—a total train weight of (electric) 407.5 tons and (steam) 427 tons. The maximum speed developed in this run was approximately 57 miles per hour (the electric locomotive being about one train length ahead at the end of 1,500 feet on account of the rapid acceleration) while the same electric locomotive running light has reached a speed of 85 miles per hour.

THE CHANGES OF ONE LIFETIME IN THE MACHINE SHOP.

By Egbert P. Watson.

LOOKING backward over half a century of intimate acquaintance with machine work in various branches—active, personal participation, as a means of livelihood—I can see many milestones marking the progress made in machine tools, and in the methods of doing work. An experience of that length runs back to the time when there were but few tools, and those of the rudest character as compared with the splendid machines for all purposes that are weekly illustrated in technical journals; and, although not quite in "the sere and yellow leaf," I thoroughly appreciate the differences between this day and that of the olden time when metals had to be dressed to dimensions by the hammer and chisel and file. To be a "machinist" capable of all around good work then meant much more than it does today, when any man who has attended a special machine for a few years lays claim to that title, though he can not prove his right to it when put upon any job that comes along. I have also, during the period mentioned, seen many ambitious projects, which were to revolutionize this or that method or machine, put to flight and abandoned because they were mechanically impossible. These schemes were abandoned at that time only because the devisers of them could not make the thing go, for one reason or another; but this has not deterred latter-day experimenters from investing in them, in the full faith that they have at last discovered a mechanical philosopher's stone that would transmute base metals into gold.

The materials that pioneer engineers had to deal with were iron and steel chiefly—but what kind of iron and steel? By no means that in market today. The iron was either red- or cold-short usually, and crudely rolled to some size not on any rule. The squares would be ¾-inch, one way by ⅞-inch the other way (so it could be sold for either size, the boss blacksmith used to say) while the rounds were more oval than any other shape, and the flats left much to be desired. A quick way of testing for quality was to strike a bar over the horn of an anvil; if it broke short, it was bad, but if it could be bent cold and drawn to a fine point without splitting it passed as "pretty good iron."

There were irons of unquestionable merit—"Sligo" for one, "Salisbury" for another, and "Lowmoor"—but the last was too high-priced for general use; as much as 14 cents a pound sometimes. There were also Swedish and Norway irons, but they were used only where it was not safe to take any chances; and as for steel it was, as a rule, not used except for tools, springs, or valve stems. The popular view of it was that it was brittle and unreliable for sudden strains.

Machinery steel, as we now know it, was unheard of; the only way to employ steel was to anneal it several times, in wood ashes or spent lime from gas-house retorts, or by heating it to dull red in the dark and then quenching it in cold water. After such treatment it would sometimes be soft enough to work in machine tools, but full of pin spots that a file would not touch. For cutting tools it was generally stubborn and perverse; sometimes it would temper without trouble, but at others neither fire nor water would avail to make it endure. This was English steel of various brands, for American tool steel was only in the experimental stage and it was a long time before it got past it.

Forgings in 1845-50 were as a rule of excellent workmanship, close to sizes on drawings and in any desired form; cranked shafts were then as now forged solid as to their webs, and afterward slotted out—when there was such a machine as a slotter in the shop; for the most part there was none. Then the throw was drilled out and chipped for the crank-pin. All this is of the past now, for special machines finish the crank-shaft complete for almost what the forging cost fifty years ago. Forgings fifty years ago were for the most part (when of any size) flogged out of the stock by strikers with 20- and 25-pound sledges; steam hammers were few and far between, and even tilt or trip hammers were not common, except in tool shops where there was constant use for them. As late as 1875 large shafts for marine engines—shafts 18 inches in diameter—were made in New York city "by hand," so to call it; billets made from selected scrap were first welded to about 4 by 3 inches by 24 inches long and then welded on to a porter bar, and continually added, one on top of the other, until the desired size and length were attained. No one of these shafts ever broke through defects.

Prior to the time I began my apprenticeship to the machine business in 1851, marine engineers were greatly troubled with the shaft question when higher-powered engines came into use. Cast iron was used for some of them, but, as might be supposed, it soon showed its unfitness for the strain, and some shafts were made from iron bars about 1 or 1½ inches square, in bundles, laid up to the required diam-

eter and "skin-welded," so to call it, exteriorly—evidently by sledges, since there were no power hammers that could do the work. I saw one such shaft taken out of a river steamer, the Mountaineer, that had broken short off, and the square bars were plainly in evidence, welded for about an inch deep exteriorly; that was the last experiment in that direction. Then shafts made from boiler plates were tried, riveted up in sections just as vertical boilers are. A steamer called the New Globe, I think, ran on the Hudson river with such a shaft for many years; as I now recall it the diameter was about 18 inches, and when running it rang like a bell.

It was not the shafts alone which gave trouble by breaking, but the cranks as well. These could be cast and afterward reinforced by wrought iron bands shrunk around them; these bands were 2-inch square iron, and two of them passing around the crank from top to bottom made the casting as strong as a forging, apparently. I never knew one of them to break, except one that had been cast for a long time and laid out doors as a spare some years, no one knew how long. One day it exploded with a noise like a six-pounder, rent from top to bottom by some internal strain which time had not removed. But the engines increased in power, and cast-iron cranks had to give way to wrought-iron; huge forgings these were, some four feet across the shaft hub, weighing four tons each. The hole for the shaft was bored out of the solid by an immense drilling machine which stood 30 feet high and was called the "giraffe"; this was the progenitor of heavy machine tools, and it well fulfilled its task. The spindle was 12 inches in diameter, and had a tool carrier on its end which held channeling tools that soon removed a solid cylinder, leaving a hole which was afterward bored true and faced on the hub, so that the crank was finished complete without going into a lathe. Radial drills now do the same thing that this vertical drill of half a century ago did, with the additional convenience of a longer radius of action.

It should not be assumed, therefore that there were no machine tools of any importance fifty years ago in use in the United States, for that would be quite wide of the facts. There were large planers, capable of taking castings 6 feet wide by the same height, and 20 feet long; also lathes which would handle steamboat shafts of 30-tons weight and swing a flywheel 20-feet diameter. Some of these lathes were triple-geared, and driven by round raw-hide belts about an inch in diameter, which ran at a very high speed, so that our forebears were by no means ignorant of the fact that increasing the speed of a belt added to its efficiency. I have seen an intermediate shaft for a large

oscillating engine, which (the shaft) was built up of the several members by shrinking them together; all assembled, the shaft was put into the lathe and each bearing turned on its own centers, so that there was no possibility of the bearings being out of parallelism with the others. As the bearings were very large and the cranks 4 feet from center to center, the net weight was much over 40 tons, including the necessary counterbalances, but the lathe walked away with the load all right, except for a little trembling all over, and that would be a job for the best machine tool of its class today.

The shop of which I have been speaking had been in existence for twenty-five years when I entered it, so many of the tools in the finishing shop had been made in 1835, and for that matter much before it; some of the lathes particularly had wooden shears for beds, plated on top where the carriage ran with iron about 3 inches by ¼ inch thick; these lathes were exclusively for hand tools, as there was no slide rest, or carriage—simply the common rest for hand tools, but excellent work was done upon them for all that. For many years after I entered the shop all the poppet valves and their stems, 1½ inch diameter by 36 inches long, having a thread chased on one end for 10 inches or so, of about 8 pitch, were turned up on these hand lathes, and those who have never done such work cannot appreciate the manual skill it requires to execute such jobs, day in day out, without spoiling some of them. Be it known to those of the present generation who may chance to read this that it requires a high quality of manual dexterity to chase a thread of about 6 pitch on a steel shaft, and keep it true for about 10 inches without having it "drunken" in some part of its length, but this is what an old-time machinist did, year in year out, without fault; there was never a bad job, but every one was absolutely correct to dimension and fit. There were screw-cutting lathes in the shop at that time, but they were not used on the work in question, because the hand-tool man could do the work better and just as quickly. The same is true of a good deal of heavy planer work; rather than get the gang of laborers to truck the work some distance to the tool, hoist it onto it, and bring the job back when it was done, a force of chippers would attack it and soon complete it; but there were chippers in those days who were expert in their line—they have passed away because modern facilities in the way of electric cranes, and pneumatic tools have dispensed with their services. In one shop where I was at the period named they had a "Jim Crow" planer, so-called because it took a cut on both travels of the bed, going and coming back; but it was not a success, except upon a finishing cut with a

broad-faced tool. The tool post revolved in a box by means of a round belt with a stop on one side of the box to bring the tool into position for the reverse cut, but the tool bounced when it struck the stop and stood nowhere, so the roughing cut was double or treble what it should have been, and stalled the machine.

The first attempt to mill surfaces by rotary cutters that I am cognizant of was made by a machine called a "slabber," which dressed up hexagon nuts strung on a vertical mandrel, doing two sides of the nuts at once, and it was a vast improvement on the chipping and filing methods which had preceded it. This was, I have always thought, the genesis of the present milling machine, for the reason that this tool was unknown in the trade at that day, and for many years afterward.

There were some planing machines which were unique of their kind, being operated by a chain in lieu of rack and pinion, or a screw —and when they reversed motion the attendant knew it, for it would jar him off of his feet, if he was not on the watch for it. The small lathes in the finishing shop, 14 and 26 inch, left much to be desired in construction and operation, being so light in body that they trembled all over with a very ordinary cut, and were unreliable for truth, both in boring and straight work; if a man desired to bore a pulley for a shaft he would have to humor the tool every way in order to get a true bore. There were no chucks either, as we now understand such appliances; the only way to hold a circular job was to use offset straps bolted to the face plate, or in the case of a job which admitted of it, to use an oak block about 3 inches thick, bore it to the right size, and drive the piece to be bored into it. Later came the slotted face plate with four jaws adjusted to size with screws working through them, and later still, about 1852-3, the scroll-chuck which held a round job true without any adjustment; but they were soon put out of commission by the men using levers about four feet long to set them up, alleging that the work slipped in them. It was a long time before the men got over their prejudices against a new thing.

It was the same with twist drills as they are now made. These last were not unknown in the machine shops of half a century ago, for there was a sort of steel auger in use for deep holes; it was not very popular, as it was alleged that it did not clear itself, as may be supposed, for it was simply a steel bar drawn flat and afterward twisted in a vise into helical form, and used, without turning just as it came from the tool-dresser. The first commercial twist drill made and sold in hardware and machine-tool shops was devised by Samuel Morse of

East Bridgewater, Mass., who organized a company to manufacture it for the trade, and carried on the business under the style of the Morse Twist Drill Company which is in operation to this day at New Bedford, Mass. About the same time one Arnold, a machinist in the employ of a firearms company in Newark, N. J., also got up a twist drill of the same general conformation as Morse's, but the enterprise was never pushed and therefore languished.

Tools of Precision.—The last half of the Nineteenth Century was marked by a great awakening, so to call it, in regard to the methods in use for constructing work. Up to 1850 and for some time after that period it was a common practice to go by the drawings furnished, to some extent; but they were not absolutely depended upon, for the simple reason that there was no standard of measurement which could be relied upon for accuracy. The unit of measurement was the inch—but what kind of an inch? According to the boxwood rules which every man carried in his pocket, it was 1/32 over or under a standard inch; hence it became absolutely necessary to leave details larger than the sizes marked on the drawing and fit one piece to another all the way through. This was unsatisfactory in every way, as will be readily understood now, and gave rise to much needless argument and recrimination, as to the ability of the men to work to the drawing. Personal conflicts were not unknown, and so much confusion arose that it was essential to make a change. The steel scales so common now were not then in market, but the Whitworth plug and collar gauges were, and a full set of these were imported and given to the foremen in several shops. The use of them was explained to the men, but it soon transpired that some "lewd fellows of the baser sort" were forcing the caliper gauges over the shafts, and those who were in charge of the collar gauges, which were intended as standards only, had given them to lathe hands to use for sizing shafts, which they proceeded to test for accuracy by trying to drive the collars on the ends of jobs with a hammer. The end of the experiment was that the gauges were practically ruined, and were withdrawn; but about that time the American steel rules, or scales with fine divisions, were marketed and proved entirely satisfactory, and a great impetus was given to accurate machining.

But it was not all plain sailing even then, for the reason that the men would not recognize anything less than 1/32 of an inch as a reasonable limit of inaccuracy; the idea that there was such a division of an inch as the 0.01 part of it seemed hard to realize, and they would sarcastically demand to know if they had to set their calipers

to lines they couldn't see without a "spyglass" while the "tenths" and "twentieths" of an inch were declared to be useless because they wouldn't divide by anything; how was a man to use "half of a twentieth" in measuring his job, when there was not any such mark on the rule? They said that if the improvements were insisted upon they would have to get magnifying glasses in their kits, but they soon became familiar with the new order with benefit to all concerned. It was a long time, however before the 0.01 of an inch dimension ceased to trouble some of the finishers; it was to them in the nature of an unreasonable exaction, until one day a traveling salesman showed them that they habitually worked much closer than that, in their daily output, and that they had been scared by a name alone. This man had a plug-collar gauge with him, the plug whereof had been purposely reduced to 0.001 part of one inch smaller than the collar. When he put the plug into the collar it rattled all around it, and daylight was plainly visible through it; every one acknowledged that it was a practical demonstration—that work executed within the 0.001 part of an inch was by no means good work, unless it might be for a sliding fit, and even for that it was too slack.

It must not be inferred from what has been said in the preceding lines that there was no good work done about the middle of the last century in machine shops of the United States, for that would be quite wide of the facts; there is no better done, on the average, in ordinary shops than our predecesssors in the machine business did half a century ago, so far as fitting is concerned; but the methods employed could not be used now for the reason that they would not pay. Time was cheap in those days, good machinists getting only $9.00 a week, and some just out of their time $6.00 a week, doing just as good a job as the regular journeymen, so fitting one piece to another was not so objectionable as it would be now.

In the matter of small tools, nothing gave more trouble and annoyance than the taps and dies, because there was no standard thread recognized for special sizes of bolts; a ⅝ bolt might be either 10 pitch or 9 to the inch, according to the notion of the man who made it, and these sizes would get mixed up in a most vexatious way in the tool room, or the place that was called a tool-room; this was merely a sort of store room where the taps were put in a box, when any one took the trouble to bring them back after use. When a tap was needed the man took the first that came to hand of the required size; this was tried by calipers, for there was no mark on the shank either for pitch or thread, and it sometimes happened that holes were tapped

for stud-bolts that could not be threaded with dies in use, because one or the other was found to be a bastard thread, made for some repair job and thrown into the box because it might come handy some other time—when it should have been cast into the scrap heap in the first instance, lest it might make trouble upon regular work. Moreover, many of the taps were cut upon lathes which had lead screws that were worn out—known to be so—but so long as they would cut a thread they were retained in use; a little thing like a quarter or half of a thread out the way was nothing to make a fuss about. As a rule the men took pride in their tasks, and considered a bad job a serious reproach upon their ability and worried over it as if it was a personal matter. There were but few "handy men," so-called—none at all who ever touched a machine tool to operate it, or otherwise than as a laborer to help shift jobs. That would have been resented promptly by the workmen, and though not given to striking they would have left the shop in a body if laborers had been allowed to handle tools; there was, indeed, one man who ran a heavy drill press on routine work which merely required him to keep the drill cutting, but he was 70 years old and a sort of pensioner, ranking as a laborer only.

To modern machinists who may chance to read these brief annals of the old-time machine shop, they may serve to mark the wide difference between that time and the present, when every transaction in a shop is carried on seriatim, according to a preordained plan and system. In spite of the waste and loss everywhere apparent in the old-time shop, the proprietors must have made money, for it existed for nearly seventy years (one of the old "bosses" is still living at ninety years of age) and it is only about two years since the last stone of the old shop was razed to the ground.

In preceding pages I have given the prices for labor nearly sixty years ago, but it must not be inferred from the low rates ruling at that time that the artisans suffered for food or clothing; they had an abundance of both, and good rooms to live in. Before the war for the Union, staples were very cheap—with the exception of flour, which was not; but beef of the finest quality could be had for ten cents a pound, butter for the same, and such food as fish and oysters for a few cents, five or six, per pound or per quart respectively, so that the commissariat was ample. Clothing was also cheap; pantaloons of cotton jear were universally worn in summer; these with a hickory shirt cost $1.50 and would last several months; for holiday wear satinet suits were generally used, and looked well until the cotton back began to show up. Workmen who, in those days, did not attempt to compete with others of larger means.

EDITORIAL COMMENT

FROM the testimony lately taken before the Senate Committee on the Panama Canal—the study of which we most cordially commend to all who are patriotically interested in the great National enterprise on the Isthmus—it appears that unless a radical change is made, we shall not build the "Roosevelt Canal" promised by Mr. Shonts, but the "Cromwell Canal."

Mr. William Nelson Cromwell is a man of phenomenal activity of intellect and executive ability. Whatever the motive, his efforts in the earlier stages of the business were effective in enabling the United States to acquire the rights, franchises, and property necessary for completing the best possible waterway from Atlantic to Pacific. But we seem to have reached the point where the ways fork, and where the interests of Mr. Cromwell and the interests of the country follow different paths.

For our part, we are unfalteringly loyal to the welfare of the United States, and to the best of our ability we shall endeavor to advance it, wherever that course may lead us. At present, it seems to lead directly away from Mr. Cromwell.

* * *

THE recommendation of the lock "type" for the Panama Canal, with a summit level 85 feet above sea, as reported from the Isthmian Canal Commission, appears to be based largely upon the considerations which have made this Magazine a consistent adherent of substantially the same project. We eliminate for the present the factors of time and cost, although they tend to confirm the same conclusion; they have never seemed to us controlling, and as Mr. Wallace points out elsewhere in this issue, they are in any case wholly dependent upon the mode of administration adopted—whether directly by the Government or under honest and able contractors.

The arguments for the summit lake and its attendant features have always appeared to us to be the fuller and more certain solution it affords of the problems of the Chagres and of Culebra, and the much greater ease and security it offers to navigation; and these cover two-thirds of the argument by which the Commission supports its finding.

* * *

THERE is another matter connected with Panama affairs in which we are glad to note that the Administration sees the truth as it had already presented itself to us. The close parallelism of the views may be best indicated by quotation:

From an Editorial in THE ENGINEERING MAGAZINE for February, 1906.

"The greater part of the machinery of the Federal Government is diverted from its proper functions to the carrying on of the Canal investigation, and the whole executive management of the Canal is distracted from constructive effort to the business of being investigated.

"We hope that the present inquiry may carry the light into the farthest corners of the Isthmus and of the departments at Washington—that every one who has evidence to give or a grievance to allege may appear and be heard to his heart's content. This is the time for it. But as sincere and consistent advocates of the best canal, for the least cost, and in the shortest time possible, we most earnestly hope that the era of talk may then give place to the era of work."

From Secretary Taft's Speech at Detroit, February 10, 1906.

"A word as to investigations. We have had a good many recently in Washington. The President and all in authority are glad that the Senate Committee is now making a full and complete investigation into every statement of improper conditions of any sort on the Isthmus, regardless by whom made.

"But after one thorough investigation has been completed and every truthful man and every liar has been heard, then let the work go on. You can't be answering questions and building a canal at the same time. You can't have the chief engineer and the other constructing officers engaged in that work both in Washington and on the Isthmus.

"Therefore I say that all those who wish to be heard ought to be heard now, or ever after hold their peace."

Of course, the Secretary can refer (as we did) only to the scrutiny of what has been done. The investigation, no matter how thorough, cannot forestall the critics of the future. After another year of work under the Government, another party of opponents may—and very probably will—have the desire and the power to investigate all over again. Our editorial just quoted followed with the prediction that "as long as we persist in our present policy these conditions will be prolonged and repeated."

With the canal committed to competent and thoroughly responsible contractors, both the constructors and the Administration might go steadily about their own proper affairs, and the land might have peace, so far at least as the Isthmian Canal is concerned.

* * *

THE report of the State River Improvement Commission, lately made public, proposes the control of the floods of the Mohawk and Sacandaga by the construction of storage reservoirs, in connection with the reforestation of the upper basin of the streams—the object of the latter work being, of course, not any problematic influence upon climate, but the certain one upon the rate and time of run-off. With restoration of the large wooded areas, the rainfall would pass much more gradually into the streams; and with the artificial storage provided to receive the excess volume of freshets, not only could flood damage be largely prevented, but the regimen of the stream could be kept much more nearly regular and a serviceable stage maintained through a large part of the year as the stored waters were gradually released.

* * *

THIS is an interesting adoption of some of the principles enunciated by Professor Haupt in his Franklin Institute address upon the Regulation of the Mississippi, reviewed in this Magazine in December, 1903. In this he pointed out that "remedial measures must evidently be directed towards the prevention of simultaneous floods, and the accumulation of large volumes of water which must be carried in a congested conduit for long distances before it can find relief," and he suggested "impounding reservoirs upon the tributaries, . . . reforestation" and other measures specially adapted to the Mississippi problem.

We are glad, in carrying back still further the review of our own discussion of the same question, to find substantially equivalent measures advocated under the auspices of THE ENGINEERING MAGAZINE just eleven years ago. An article on "The Causes of Floods in Western Rivers" in our issue of March, 1895, recommended reforestation, in connection with the installation of a "system of dams by which the greater portion of the freshet in the minor rivers could be retained in great semi-natural reservoirs, and an important double purpose thereby be served: first, the avoidance of the successive discharge of tributary flood waves upon the very crest of flood wave in the main channel . . and second, by the gradual liberation of the stored waters, the maintenance of a navigable stage in the principal stream for a much longer season than the present average." The article in question showed how, under conditions existing in the Central States, much might be done within the limited means even of individual enterprise, and dealt at some length with the incidental gains to be secured. It was an anticipation of the advantages not only of forestalling flood damage, but of realizing true economy in the conservation of our water resources—an anticipation which we are glad to recall under the present approval of the leading authorities on the subject.

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

THE PROTECTION OF THEATRES FROM FIRES.

LESSONS FROM THE FIRE TESTS UPON THE EXPERIMENTAL THEATRE BUILDING AT VIENNA.

Oesterr. Ingenieur und Architekten Verein—Gesundheits-Ingenieur.

WE have recently reviewed in these columns the address of Mr. John R. Freeman upon the methods of minimizing the fire risk in theatre buildings and public auditoriums, and as a satisfactory supplement to this study we now have the account of the tests which have been made in Vienna by the Austrian Society of Engineers and Architects on a model building, designed to reproduce the conditions existing in the structures in which thousands of lives are exposed to danger from fire every evening. The Austrian society has done excellent work in the past in subjecting theoretical deductions to the ordeal of practical test, and has not spared expense, either in money or service in such experimental researches. It is only necessary to mention the exhaustive trials made several years ago by this same organization upon the resistance of large masonry arches to remind the engineering profession of the thorough manner in which such investigations have been conducted.

Nearly two years ago a committee of this society was appointed to make a study of the best methods of preventing disasters in theatres from fire. This committee received ample encouragement from official sources, and the result was a decision to erect a building of sufficient size to represent accurately the conditions existing in modern theatre buildings and to permit fire tests to be made upon a sufficient scale to give unmistakable indications of the right course to be followed hereafter in case of fire by managers and designers of such buildings.

The experimental building was constructed in reinforced concrete upon a scale of one-third that of a theater intended for an audience of 1,500 persons, with stage and auxiliary portions in proportion. Thus, in this building the stage is 7.50 meters wide, 6 meters deep, and 7.70 meters high. The proscenium opening is 3.35 meters wide and 2.60 meters high, behind which is a cross passage one meter wide, permitting the stage to be traversed in front of the settings but behind the curtain. The auditorium is 5.50 meters wide, 7 meters deep and 4.70 meters high, with a single gallery, and outside staircases permitting this gallery to be emptied directly to the exterior. In the back part of the auditorium is a partition made of reinforced concrete, permitting the conditions within to be observed through glass windows.

Several outlets for smoke and gases were provided, the principal one being an opening over the middle of the stage, 2.30 meters long and one meter wide, this being made with two flaps so arranged as to be opened from below by iron connections, the area of the full opening being five per cent. of the stage area, while smoke flues were also arranged at the four corners of the stage. An opening one meter square was also arranged over the auditorium, with double flap opening, all these flaps being arranged to be operated from the outside of the building. An iron curtain was placed in the proscenium opening, arrranged to be guided in iron grooves, this curtain being made of slats 0.6 mm. thick and 12 mm.

deep, and covered with asbestos 4 mm. thick. Sprinklers of the Grinnell pattern were arranged over the stage and in the auditorium, those in front of the stage being placed so as to direct the water upon the curtain. Air for combustion was admitted on both sides of the stage near the bottom, and gas, oil and electric lighting systems installed to permit of the inspection of the action within.

In order to enable the actual conditions on the stage and in the auditorium to be studied, there were fitted recording pressure gauges and pyrometers both before and behind the curtain, together with a gas analysis apparatus for the determination of carbonic acid, oxygen and carbonic oxide, and a recording device was fitted to measure any bulging of the curtain towards the auditorium.

It was desired to reproduce, as nearly as possible, the actual conditions on the stage, and hence this was fitted with old theater decorations and rolls of paper hung upon screens, these being soaked with petroleum in order to insure violent combustion, and so distributed as to correspond to the proportion for a fully set scene on a stage of normal dimensions.

Four sets of trials were made in this experimental building, these being intended to reproduce, as far as possible, conditions which may exist in actual theater structures during performances and when audiences are exposed to danger.

In the first set of experiments all the outlets above the stage were closed, the curtain was up, and the opening in the ceiling of the auditorium was half open, the lights all being turned on. This practically represents the most dangerous state of affairs, and one which is most generally found in existing structures. Within a few seconds after the inflammable material on the stage was ignited the auditorium was filled with smoke and gas to such an extent as to render it almost impossible for life to exist, the draught from the openings in the front part of the building causing the flow to be outward through the proscenium arch. The dropping of the curtain furnished no relief, since this simply compelled the gases and flames to pass through the cracks around and beneath the curtains in jets at a high velocity, this only adding to the danger and intensity of the fire.

This test verified very fully the contention of Mr. Freeman that the absence of openings over the stage is the most prolific cause of loss of life in theatre fires, and the subsequent tests on the Vienna model theater confirm this view.

The second series of tests differed from the first only in having the iron curtain lowered immediately upon the outbreak of the fire, this being effected by providing an automatic release to the curtain, operated by fusible connections. In this case the auditorium filled with smoke more slowly, so that it appears probable that people in the auditorium might have an opportunity to escape.

In the third series of trials the outlets over the stage were left wide open, while that over the auditorium was closed, the iron curtain being kept up. The result was what might be called a "show performance," the entire contents of the stage being consumed without impairing the air in the auditorium, which could be occupied throughout the entire test with safety, the only inconvenience being from radiant heat in the immediate vicinity of the stage. Under such conditions in an actual theatre the entire audience might remain seated and witness the spectacle as if it were a portion of the regular performance.

Finally the ideal conditions were arranged, these including the provision of automatic release both to the openings above the stage and to the lowering apparatus for the iron curtain. Immediately upon the outbreak of the fire, the curtain fell and the fire was wholly confined to the stage, the products of combustion passing out through the opening above the stage, the curtain cutting off radiant heat from the auditorium. An additional element was added to this test by causing the outlets from the auditorium to be suddenly opened, but the only effect of this was to produce a brief discharge of smoke about the curtain, this being almost immediately overcome by the superior upward draught over the stage. When this test was repeated with the automatic sprinklers in operation, the fire on the stage was promptly and automatically extinguished, the steam passing up through the stage opening, and not entering the auditorium at all.

One of the principal subjects of discussion in connection with these experimental tests was that relating to the advisability of attempting to use automatic devices for opening the outlet for smoke and gas above the stage. It is evident that, apart from proper precautions for the prevention of the origin of fire, this matter of providing a free and immediate discharge for the products of combustion is most important, since the slightest delay in this respect results in the delivery of smoke into the auditorium, causing certain panic and confusion, and probable suffocation to those in the upper galleries. Fusible connections require the production of a certain amount of heat before they can become effective, and in the meantime sufficient smoke may reach the auditorium to cause alarm to the audience, with all the possibilities of panic and consequent confusion, and it is not impossible that after a long lapse of time any automatic device may become neglected and inoperative when the alarm does come. If the rule requiring the presence of firemen in the wings during performances is enforced, it is possible that the control of the smoke vents and the safety curtain may well be placed in their hands, and in such case the enforcement of frequent fire drills should insure the free working of the apparatus at all times.

The results of the Vienna experiments confirm in all respects the position taken by the foremost engineers who have given the subject consideration, and there is no reason why, in view of the positive knowledge thus obtained, that entire security should be provided in all places of public entertainment.

THE SMOKE ABATEMENT QUESTION.

THE CONFERENCE UPON THE BEST PRACTICAL METHODS FOR ABATING THE COAL-SMOKE NUISANCE IN LONDON.

Royal Sanitary Institute—Coal-Smoke Abatement Society.

ONE of the important scientific conferences, recently held in London, was that conducted under the joint auspices of the Royal Sanitary Institute and the Coal-Smoke Abatement Society to consider scientific and practical methods for minimising the smoke evil in the metropolis.

Beginning with an address prepared by the president, Sir Oliver Lodge, advocating the general use of gas fuel, the conference treated of the many sides of the problem, including the injurious and unhealthful effects of the present primitive method of consuming fuel, and the best method for improvement.

Among the papers presented at the conference we may note one by Mr. Arthur J. Martin, dealing with the relation of bituminous coal smoke to the production of black fog, and discussing the practicability of substituting gaseous for solid fuel for commercial and household purposes.

There is no doubt that climatic conditions are largely responsible for the prevalence of fog during certain portions of the year in London, but the confusing, expensive, unwholesome black fog is undoubtedly caused by the presence of the finely divided carbon in the atmosphere, aiding in the separation of the moisture in the vesicular form, and mingling with it to foul the air and obscure vision.

"Few people probably realise how large a quantity of coal is consumed in London every year. According to the Coal Tables issued by order of the House of Commons in 1904 the weight of coal consumed in the Metropolitan police district during 1903 was over fifteen million tons. Of the six-and-a-half million people composing the population of greater London four-and-a-half million reside within the city and the county, and it is fair to assume that the population inhabiting the smaller area burns its due proportion of the coal consumed in the larger.

"At this rate 10,400,000 tons per annum are burnt every year on 75,000 acres, an average of 851 pounds per acre per day. On a moderate computation the daily mid-winter consumption is probably not less than one-and-a-third times the average, or say 1,135 pounds per acre per day.

"Every pound of coal requires for its complete combustion at least 140 cubic feet of air, or 259,000 cubic feet per acre, equiv-

alent to a uniform layer three-and-two-thirds feet deep. The amount of air consumed by coal fires in one week forms a solid mass twenty-six feet in depth extending over the whole area of the metropolis. The London householder sometimes experiences an unpleasant shock on receipt of his quarterly coal bill. It would be well if he sometimes gave a thought to his air bill.

"The air thus consumed is not abstracted from the atmosphere. It would be better if it were, instead of being, as it is, sent back and supplied for human consumption, with its burden of unconsumed coal and the products of more or less complete combustion. Fortunately the products of combustion, amounting as a minimum to something over 5,000,000 tons per week, do not as a rule fill up the lower strata of the atmosphere, but owing to their warmth and consequent lightness, pass upward, and under favorable circumstances are dissipated by the air currents. During a black fog, however, as both eye and nose can testify, large quantities of these products drop back to the earth."

So far as the method of removing the smoke nuisance goes, Mr. Martin, makes, broadly, two propositions, one being the imposition of a fine or penalty for the production of smoke, or possibly a remission of a portion of taxation to those whose premises emit no smoke, and the other being the provision of a cheap supply of gas fuel to take the place of coal. The second proposition properly precedes the first, since it would be useless to prohibit or penalize the production of smoke without also providing a smokeless fuel at a practicable price.

Ordinary illuminating gas would be too expensive to be generally used as a substitute for coal, but Mr. Martin tabulates other gaseous fuels in comparison with coal and with illuminating gas. This table shows, what is well known, that on a basis of actual calorific value coal has a heating power of six or seven times that of gas of the same monetary value. This advantage on the part of the solid, smoky fuel, however, is neutralised by the fact that a far less proportion of the heat in coal can be utilised than with gas. A gas cooking stove need not be lighted until needed, and the heat is concentrated where it is used to great advantage and the flame is extinguished as soon as it is no longer required.

The whole question may be reduced to a matter of cost, not of total heat units supplied, but of heat units utilised.

Broadly, it has been stated, that if the price of gas can be reduced, in London, to a price of two shillings per thousand cubic feet, its utilisation for cooking, heating, and power will become extremely rapid, while, at a price of 1s., to 1s. 6d. per thousand, it would be fully able to compete with coal. It has been stated before the Royal Commission on coal supplies, that gas can be produced for 6d. per thousand cubic feet at the gas works, the remainder of the coal being due to distribution.

An important element in the reduction in the price of gas lies in the proper utilisation of the by-products. As Mr. Martin observes, there is no more fascinating chapter in the history of applied science than that of the utilisation of the tar which is produced in the manufacture of gas.

"There is no more fascinating chapter in the history of applied science than that of the tar which is produced in the manufacture of gas. Originally a useless encumbrance, which managers were at their wits' end to get rid of, it has yielded in quick succession hundreds, if not thousands, of distinct products, presenting the utmost diversity in their nature and appearance, and many of them of the greatest value in manufactures, the arts, medicine, sanitation, and the household. In the development of the important industries concerned with the extraction of these products lies one of the possibilities of reducing the price of coal gas. Having regard to the great value of coal as a store-house of valuable by-products, Sir William Siemens has characterised the burning of raw coal as 'a barbarous practice.' We may yet live to see the day when the man who uses coal to cook his dinner will be looked upon much in the same light as if he chopped up his drawing-room furniture for the same purpose."

The only way in which an abundant supply of cheap gas for fuel and power can be supplied to London is to generate the gas from the coal at the mouth of the pit, and transmit it to the metropolis by pipe lines. Mr. Martin compares the cost of transmit-

ting power by electricity with that of gas, showing marked advantages in favor of the latter. When the electric energy is generated from the combustion of coal all the losses involved in the operations of conversion and reconversion must be considered, while the practicability of storage of gas gives it an especial advantage in the very feature in which electricity is weak. There is practically no loss in the storage of gas, while the high degree of efficiency attained in the conversion of energy in the gas engine renders this a most desirable type of motor. With gas fuel for heating and cooking, and gas engines for the development of power, the smoke nuisance would disappear, and with it many other inconveniences, such as the handling of coal, removal of ashes, and much laborious and disagreeable work.

The natural place for the generation of the gas is at the collieries, thus dispensing with the most important element in the cost of coal, that of transportation.

"The generating plant at the collieries enjoys a further advantage in the facilities which it possesses for the utilisation of less expensive grades of coal, particularly of the dust and smaller fragments of which no use is at present made. It is estimated that no less then 24,000,000 tons of small coal, or more than twice as much as is consumed in London, are brought to the surface every year and left to perish at the pit's mouth. In addition to this an enormous quantity of small coal is disposed of underground by being thrown into disused workings. Some of the material thus wasted includes a certain proportion of dirt; but by far the greater part of it is good coal, in no way inferior in calorific value to that sent away for sale, and is thrown away merely because in its comminuted condition it is not suitable for many of the uses to which coal of its class is applicable, and will not bear the cost of handling and cartage.

"This waste coal, be it remembered, is got out, and much of it raised to the surface, at hardly less cost than a corresponding weight of good coal, but yielding no return of its own, its cost has to be spread over that of the marketed article, the price of which is inflated accordingly."

In order to show the practicability of the scheme, Mr. Martin gives computations for some concrete examples. Thus to generate, in the Yorkshire coalfields, at a distance of 173 miles, sufficient gas to replace the coal consumed in London in winter the following figures are given. The daily consumption of coal is given as 55,115 tons, corresponding in thermal value to 2,802 million cubic feet of gas of 617 B. T. U. calorific power, or about two million cubic feet per minute. This could be delivered through a main six feet in diameter by a pressure of 480 pounds per square inch. To compress two million cubic feet to 480 pounds per square inch is estimated to require about 575,000 horse-power. If the whole of the gas delivered were used in large gas engines the power developed would be more than nine million horse-power, so that less than six per cent. of the power value of the gas would be required for compression. In practice several pipes would probably be substituted for a single main, and Mr. Martin suggests four lines of pipe, ranging from 36 inches in diameter at the coalfield to 72 inches at the London end, capable of conveying a maximum daily volume, measured at atmospheric pressure, of about 700 million cubic feet, with an initial gauge pressure of 510 pounds per square inch. Various details of the scheme are worked out by Mr. Martin, and there appears to be nothing inherently impracticable in the plan.

So far as costs are concerned, many details must naturally enter into such computations, and many elements of uncertainty, but Mr. Martin estimates that the gas could be delivered at London for 8d. to 10d. per thousand cubic feet, to which would have to be added the cost of storage and distribution. Practically all the mechanical details involved in the compression and delivery of gas at high pressures and long distances have already been worked out in connection with the transmission of natural gas in the United States, the principal difference between the two propositions being in the source of the gas, being manufactured in one case and natural in the other.

When the advantageous conditions under which gas can be used, are realized, and it is seen that this system would entirely relieve the metropolis from the smoke nuisance, its claims to consideration will be appreciated.

THE MACHINE-SHOP PROBLEM.

PRACTICAL DEVELOPMENTS IN SHOP BETTERMENT AND THE INDIVIDUAL EFFORT METHOD OF PROFIT SHARING.

Harrington Emerson—American Engineer and Railroad Journal.

WHILE many men have been theorizing and devising schemes to obtain the maximum of output at a minimum of expense in manufacturing operations, others have been quietly engaged in putting working methods into practice and determining for themselves what can and cannot be done in enabling both employers and employees to make more money out of the business in which they are all engaged. In a paper by Mr. Harrington Emerson, published in the *American Engineer and Railroad Journal,* these questions are discussed in a most practical manner, as some abstracts will show.

"The employee wants as high wages as he can get. The employer wants his output to be as cheap as that of his competitors, for, if it is not, he will soon have to shut down his shop. Both desires are reasonable, and the problem is to reconcile them without injustice to either party. An absolutely clear understanding by both parties of the shop problem of to-day is necessary: the shop problem of to-day, not of years ago, when conditions were very different; not of years hence, when conditions no one can now foresee may prevail.

"The worker cannot be expected to work for one employer for less pay than is paid under similar conditions for the same work by another employer. The wagepayer will not pay higher wages than the current rate, or than business conditions permit. There may be, however, quite a gap between the wages paid by competitors and the higher wages the employer would be willing to pay if it can be proved to him that it is to his advantage to do this. Wages above the current rate cannot therefore be agreed on in advance of performance, but should result from individual effort.

"It is to be made plain to the employer that not by an increase of expense, but by a readjustment of expenditures, he can with advantage to himself give higher pay than the average; and it is to be made plain to the wage-earner that the receipt of higher pay must depend on his own individual character, skill and effort. Up to a certain point, competition and combinations can force wages up, sometimes generally, sometimes only locally and temporarily; but beyond this point there is a possibility of higher than the average pay, to be brought about only by recognition of the fact that the higher rate is to the advantage of both wage-payer and wage-earner."

Formerly it was considered that the direct wages formed the greater element in the cost of a manufactured article, but with improvements in methods, machinery, and appliances the labor cost has dropped, and the cost of materials takes the first place, followed by the general expense and the direct labor. The distribution of these must be determined both by an investigation of the plant and of the accounts. Mr. Emerson is considering the shops of a railroad system, including the building and repairs of locomotives, and he shows that a condensed statement in such a case reveals the fact that materials are more important than general expense, and that these in turn are more important than labor costs, and he examines all three in detail.

So far as materials are concerned, it must be emphasized that *all* the material, of every kind, must be included. Too often it is only the material which appears in the finished machine which is taken in finding the cost, but all the material which goes into the shop has to be paid for, and it must all be accounted for. A spoiled casting belongs to the machine into which it did not go, the fitting ordered and not used must be charged likewise, and all the waste incurred by each job belongs to it. In like manner each machine must be charged with the direct labor of which it is the cause, whether it gets into the completed job or not. There is a large shrinkage in the direct labor paid for and that which goes into the finished product. If a casting is partly machined and has to be thrown away, the labor put on it is lost; if a man waits an hour for work, or for crane service, or studies an hour over a poor blue print, the

money paid for his time is lost. If a man's machine breaks down, if his belts slip, if his tools are of poor quality, if the cast iron is hard, if his machine chatters, if in consequence he takes twice as long a time as he would like to give the work, half of his time is lost, but it has to be charged for in the cost of the engine.

General expenses all have to be charged to the product, as is well understood, although the methods of apportioning them differ in different systems. There is no difference in opinion, however, about the desirability of reducing this element of cost.

"This might be reduced somewhat if fewer foremen, watchmen, timekeepers and bookkeepers, tool dressers, repair men, were required; and fewer of these men are required for good workmen than for poor. The best way, however, to reduce the percentage of general expenses is to increase output, as the larger part of general expense remains the same whether 10 or 1,000 engines are made. To increase output the employer puts his machines in good repair, lines up his shafting, renews and maintains his belting, puts in emery wheels, stops up the air and steam leaks, increases his air pressure, puts up better drawings, supplies better small tools, dresses and tempers and grinds them better, secures jigs and special devices, and makes it possible for the worker with less exertion than formerly to turn out considerably more work."

The best method of reducing the labor cost is by increasing the pay for direct labor in such a manner as to increase the output, and thus diminish the proportion of general expense. Thus, if there is an increase of 20 per cent. in wages and an increase of 20 per cent. in output, while materials increase only 10 per cent., and general expense not at all, there appears a reduction in cost of the product of 9 per cent., gained solely by the cutting out of useless wastes, and hence benefiting both employer and employee.

A practical method for applying this idea in the railroad shop required to be devised, and Mr. Emerson shows how this has been done in cases under his observation.

"The method adopted has long been in use in paying engineers and firemen on the railroads of the United States. It was thought that no better method could be devised than one adapted from such a model, and satisfactory to men of such skill and standing among the employed. In operating trains the employer makes the roadway, maintains the track, furnishes the engines and trains, installs the system of signals, makes out a time schedule, appoints a dispatcher, and then gives the train to its crew. The ability to make the schedule depends on the conditions furnished by the employer and on the diligence and skill of the crew. The latter are expected to make the schedule, but if they fail through any fault not their own, they receive time pay although the train stands still; and if for any reason they make extra effort, run more miles than the schedule calls for, they are paid for the extra miles.

"As far as possible this system has been adapted to the machine shop. A schedule is made out, a reasonable standard-time is set, such as any skilled man ought regularly to make, a schedule on which any good foreman ought to insist. For doing work in standard time the wage-earner receives 20 per cent. increase of pay above the hourly rate. He is paid this extra 20 per cent., not to work beyond reason, but to use his brains as well as his hands, to be his own foreman, to help keep conditions as they should be, to assist the employer in maintaining high efficiency in tools and machines.

"If for any cause whatever he does not maintain schedule standard time, he is still paid an extra amount until time-and-a-half has been used on the job. If he falls below time-and-a-half, he still receives his regular hourly rate, which is never interfered with. If, however, he does better than standard time, then he is given all the gain due to his own time. If standard time is 1 hour, if the rate is $0.25 an hour, if the extra pay is $0.05, making a total of $0.30, then, if the work is done in one half-hour the wage-earner is paid $0.30 for one half-hour's work, or at the rate of $0.60 an hour. If, however, he takes 2 hours on the job, he receives $0.50, or at the regular rate of $0.25 an hour. This shows why it is possible by unusual and extraordinary effort to earn a large extra amount.

"This method of profit-sharing, of rewarding individual effort of both employer and employee, is utterly different from piecework, with which those who have not investigated it have confounded it. In day work the employee is paid for his time, and he gets the same wages whether he works extraordinarily well, badly, or not at all. In piecework the employee is not paid for time, but for output. He takes all the risks of conditions over most of which he has no control, and if he seems to make too high wages the rate is often cut. Under the individual effort system the wage-earner is guaranteed his regular hourly rate irrespective of output. It is the foreman's duty as well as his own to avoid unnecessary delays. His hours are definite both as to beginning and end; his nights and Sundays are his own, and overtime being recognized as an evil to both employer and worker, it is eliminated as far as possible, the employer being forced to pay time-and-a-half for every extra hour. Wage-earners have contended for shorter hours, yet with opportunity to earn regular rates of wages. Under the individual effort system a man can work eight hours, yet earn as much as he formerly earned in ten hours."

This method is free from one of the great objections to piecerate systems, in that the rate cannot be cut, because there is no rate by the piece, and if any attempt is made to cut the standard time the workman can fall back on the day rate and make such an attempt most unprofitable for the employer. All the trouble and expense to improve conditions will be in vain unless the employer can induce the wage-earner to co-operate; and the easiest method to secure co-operation is to offer an opportunity to make an increase in pay.

"Does the individual effort system result in discharging old men because they cannot attain the times of younger and stronger men? This question provokes a smile. The 20 per cent. extra pay is given, not for hard work, but for head work. The younger men may not know it, but the older men are wiser, and if they do not have the bull-strength method of accomplishing, they supplement energy with intelligence in running a machine or planning an operation. They make few false moves, they take the stitch in time, they know that a carefully tempered and ground tool set at exactly the right angle will cut easier, faster and longer than a tool selected and set without the knowledge that long experience alone gives. Young men by driving their machines at an extraordinary rate have earned extraordinary pay, but it is the older men who in the long run will draw the most extra pay, who turn out the most reliable and satisfactory results. Some of the most productive workers are men between 50 and 60: productive not because they use their muscles, but because they use their heads."

AUTOGENOUS WELDING.

THE USE OF THE OXY-HYDROGEN BLOWPIPE FOR THE COMMERCIAL PRODUCTION OF WELDED SEAMS IN METALLIC STRUCTURES.

E. Wiss—Verein Deutscher Ingenieure.

THE art of welding is doubtless as old as the use of iron in the arts, and its development, from the manipulation of pieces within the limits of human strength at the blacksmith's forge, to the massive productions of the steam hammer and the hydraulic forging press its operations are well known. Within the past few years, however, there has been developed a series of methods of autogenous welding, or union of pieces by the fusion of a portion of their own substance, using gas fuel, and gradually progressing from the direct use of gas burners to the employment of the oxy-hydrogen blowpipe and more recently of the oxy-acetylene blowpipe. In a paper recently presented by Herr E. Wiss before the *Verein Deutscher Ingenieure*, and published in the *Zeitschrift* of the society, the present state of the art of autogenous welding is discussed, with interesting examples of the manner in which what was formerly a curious laboratory experiment has become an everyday manufacturing operation.

The use of water gas for welding has

already been extensively employed, the gas being taken from a holder and compressed mechanically for delivery to the burner, the air supply being controlled so as to be somewhat less than the quantity required for theoretically complete combustion in order to avoid oxidation of the metal at the welded seam. Joints thus made have shown satisfactory results, the tested strength of the seam reaching ninety-nine per cent. of the solid material, but the size and cost of the plant required limits the application of the method to establishments in which the conditions of work warrant the outlay. Apart from the character of the apparatus, it has been found by experience that the water-gas system is impracticable for sheet metal below about eight millimeters in thickness, although it has been employed to advantage for sheet iron or steel from eight millimeters up to fifty millimeters thick.

After briefly reviewing the processes of electric welding, including both the arc and the resistance methods, Herr Wiss proceeds to discuss the application of the blowpipe with mixed gases. Considering first the oxy-hydrogen blowpipe, Herr Wiss examines and compares the theoretical and practical conditions. The combustion of two parts of hydrogen with one part of oxygen should generate theoretically a temperature of 6,700° C., but by the dissociation of the vapor of water this temperature falls to 2,400° C. By an examination of the temperature of a mass of magnesite exposed to the action of an oxy-hydrogen blowpipe, using the Wanner optical pyrometer, Heerr Wiss finds that a temperature of 2,100 is actually attained. The difference is accounted for partly by the inability of the pyrometer to perceive the maximum temperature and partly to losses by radiation.

The ability to produce high temperatures by use of the oxy-hydrogen blowpipe has been known for a long time, and the principal impediment to the use of the apparatus in the arts has been the high cost of the process. It is only with the introduction of modern processes for the economical manufacture of the gases that the method has come into use in the industrial arts, but there is every reason to believe that present facilities will lead to its extended use.

Two methods are at present in use for the production of oxygen for commercial and industrial purposes. One of these depends upon the electrolytic decomposition of water for the production of both the oxygen and the hydrogen. The other remains as about the only really commercially valuable application of the production of liquid air, and depends upon the fractional distillation of this interesting liquid for the separation of the oxygen from the nitrogen in form for practical use.

In practical work it is found that more than the theoretical proportion is needed, and hence the ordinary decomposition of water, while furnishing the theoretically correct proportions of oxygen and hydrogen, is not altogether sufficient. At the same time it is found that, in the ordinary operations of chemical industry large volumes of hydrogen are released, and this may be isolated, as a by-product, and placed at the disposal of the engineer.

The production of oxygen by the fractional distillation of liquid air has already been discussed in these columns, and it is now conducted on a commercial scale in various countries. In Germany the undertakers of the Linde process are prepared to furnish oxygen of ninety-five per cent. purity at a price of 4.5 pfennigs per cubic meter, at the rate of 100 cubic meters per hour and allowing twelve pfennigs for the cost of compression it seems that the present selling price of 2.5 marks per cubic meter should be reduced very materially before long, since the manufacturing cost is about twenty to twenty-five pfennigs, including everything.

In practice the oxygen and hydrogen are used from receivers in which the gases are compressed to 125 to 150 atmospheres. In this connection Herr Wiss calls attention to the objectionable practice of lubricating the oxygen compressors with oil or glycerine, this permitting the presence of hydrocarbon vapors, which, at the temperatures of compression, may lead to ignition and explosion. Compressors used for oxygen should be lubricated only with water, which answers every purpose. There is no objection to the lubrication of hydrogen compressors with hydrocarbons, providing the lubricant is prevented from passing into the flasks in which the compressed gas is stored.

Formerly the gases were consumed in the

type of burner devised by Daniel, in which the gases were not mixed until the moment of combustion, but it has been found that a higher temperature is obtained if opportunity is given for a more intimate mixture than is thus possible. Present practice provides a mixing nozzle with a chamber beyond, from which the gases are delivered to the burner point, this latter having various sized tips provided, according to the nature of the work.

The rate of combustion is dependent upon the proportion of oxygen present. When the theoretical mixture of two parts of hydrogen to one of oxygen is reached there is apt to be a succession of little explosions and in practice it is found that the best proportion is four to five parts of hydrogen to one of oxygen, this also preventing the formation of a flame which will oxidize the metallic surfaces under operation.

Herr Wiss illustrates and describes the methods of using the blowpipe for the welding of structures of sheet metal of various irregular forms, and shows the ease with which the apparatus can be used, even upon material down to three millimeters in thickness. For complicated pieces especially, the method is more economical than other methods of working, besides which the finished piece has the advantage of being entirely seamless and with the strength of the metal in all parts practically unimpaired.

The use of acetylene in place of hydrogen is discussed in the paper, with especial reference to the application of the Fouché process of storing acetylene gas under pressure in an absorbent material charged with acetone. Since the heating value of acetylene is materially higher than that of hydrogen, a higher temperature may be produced by this apparatus than with the oxy-hydrogen blowpipe. It has been computed that the temperature in the oxy-acetylene burner approximates 3,600° C., but Herr Wiss states that an examination with the Wanner pyrometer shows the highest temperature attained in practice to be about 2,340° C., as compared with 2,100° C. for the oxy-hydrogen blowpipe. Since 1,900° is ample for the welding of wrought iron plate, the higher temperature appears unnecessary, and possibly injurious, so that there is no necessity for using acetylene where hydrogen is found amply effective.

The paper of Herr Wiss contains much useful information about a process which has already found many valuable applications, and which, with impending reductions in the price of oxygen, bids fair to become a standard appliance in the operative machine shop.

POWER PLANT ECONOMICS.

A COMPARATIVE STUDY OF THE COMMERCIAL AVAILABILITY OF VARIOUS TYPES OF PRIME MOVERS FOR POWER HOUSE SERVICE.

Henry G. Stott—American Institute of Electrical Engineers.

IT has generally been supposed that the introduction of the central power-generating station meant a material gain in economy over the use of isolated plants and separate equipments, and it certainly does seem as if power should cost less when generated wholesale than at retail. There is a growing belief among practical men, however, that the great central station is not so remarkably efficient after all, and that there are many small private installations which, if the facts were only known, were beating their more pretentious neighbors very materially, so far as the actual cost of the power in money is concerned. The central power plant engineers themselves appear to have been roused from a somewhat complacent frame of mind which existed not so long ago, and are really endeavoring to see what can be done to avail themselves of the latest systems for securing maximum commercial efficiency in the conversion of thermal to electrical energy. In a paper recently presented before the American Institute of Electrical Engineers by Mr. Henry G. Stott, this question of power plan economics is discussed very effectively, and a decided disposition to climb out of the rut is shown, which is indeed encouraging.

Mr. Stott calls attention to the fact that about three years ago the steam power plant of the electric generating station appeared to have settled down to a standard type, the various installations differing from one an-

other principally in unimportant details.

"After a long period of development a new factor in power-plant design; namely, the steam turbine, was placed on the market in commercial sizes. It is safe to say that during the last three years no other piece of apparatus has had so stimulating an effect upon the power plant. Its effect upon the entire plant has been most beneficial, for it has revived the apparently moribund superheater. This has now been so developed that superheat of 200° or 300° fahr. can be safely and economically obtained. With the development of the superheater further study of the problem of combustion has improved the efficiency of the furnace; and this most important subject is apparently susceptible of still further development.

"One important result of the steam-turbine development has been the development of condensing apparatus to such a point of efficiency that a vacuum within one inch of the simultaneous barometer reading can now be maintained without difficulty.

"Another change in the power plant has been the reversion to high-speed generators, resulting in decreased cost of the generator and its foundations, as well as saving in floor space.

"Last but not least the steam turbine has put the reciprocating engine and the gas engine on the defensive and has actually been unkind enough to throw out hints in regard to the application of Dr. Osler's proposed methods to the treatment of older apparatus.

"The reciprocating engine and internal-combustion engine have not been slow in accepting this challenge; they have responded by showing so improved an economy (especially in the gas engine) that the situation has become most interesting to the power-plant designer. It is safe to say that the developments of the next ten years will show very marked improvement in power plant efficiency."

In comparing various systems of power generation, Mr. Stott first analyzes the performance of a modern standard plant of high efficiency, and typical of the present state of the art, so far as the use of the reciprocating engine is concerned. For the detailed analysis of the losses in such a plant reference must be made to the tables in the original paper, but the principal items are: nearly 3 per cent. to the stack, 8 per cent. in boiler radiation and leakage, and 60 per cent. rejected to the condenser.

Of these items the loss to the stack is largely due to excess of air in firing, and by the use of scientific methods in the fire-room, aided by modern appliances for recording the production of carbonic acid in the gases, this loss should be reduced to 12 or possibly 10 per cent. Boiler radiation losses may be reduced by the use of larger units, thus diminishing the proportion of radiating surface, together with the employment of an air-tight casing, as introduced in London by Mr. Patchell.

So far as the proportion of the heat rejected to the condenser is concerned, Mr. Stott goes into the thermodynamics of the question far enough to show that the maximum possible efficiency depends upon the temperature range through which the engine is worked, this enabling the available margin from which further economies may be made to be determined. In this way he shows that with the present type of power plant, using reciprocity engines the stack losses may be reduced about 12 per cent., the losses by boiler radiation and leakage by about 5 per cent., and the reduction in engine losses, by using superheating, by 6 per cent., these bringing up the total thermal efficiency from 10.3 per cent. to 14.44 per cent.

Turning to possible modifications in the type of prime mover, Mr. Stott first calls attention to the combination of high-pressure reciprocating engine with low-pressure steam turbine on the exhaust, this being the arrangement originally devised and put into execution by Rateau. The reciprocating engine is most efficient in its high pressure cylinder, while the expansion of the steam is most efficient in the low-pressure portion of the steam turbine, hence the combination permits the use of the more efficient portion of each machine.

Another type of motor to be considered is the gas engine, and here Mr. Stott has some excellent and original suggestions.

The high thermal efficiency of the gas engine is fully established, and the principal delay in its introduction for the power house has been due, not to the engine, but to the gas producer. Still, there are certain difficulties in connection with the engine itself,

and this point is the one to which Mr. Stott has given attention.

"The great objection to the use of the gas engine for electrical purposes has been: first, its lack of uniform angular velocity; secondly, its uncertainty in action and high cost of maintenance; and thirdly, its inability to carry heavy overloads. Recent developments have removed the first and second objections; and a period of vigorous development has resulted in placing the gas engine in the front rank of claimants for attention as a prime mover.

"The total investment for a gas-producer plant, all auxiliaries, gas engines, and electric generators, has been reduced by the elimination of the gas-holding tank to a point where it is now practically on a par with a first-class steam plant using high-grade reciprocating engines.

"Where natural gas or blast-furnace gas can be obtained the gas engine has outdistanced all competitors; and now that some of our large manufacturers have taken up in earnest the problem of designing producer-gas plants, it is safe to say that rapid developments will result.

"The records of operation of several important installations of gas engines in power plants abroad and in this country seem to indicate that only one important objection can be raised to this prime mover, and that is that its range of economical load is practically limited to between 50 per cent. load and full load. This lack of overload capacity is probably a fatal defect for the ordinary power plant, more especially for the average railroad plant operating under a violently fluctuating load, unless protected by a storage-battery of comparatively large capacity.

"Over a year ago, while watching the effect of putting a large steam turbine having a sensitive governor in multiple with reciprocating engine-driven units having sluggish governors, it occurred to the author that here was the solution of the gas-engine problem; for the turbine immediately proceeded to act like an ideal storage-battery; that is, a storage-battery whose potential will not fall at the moment of taking up load, for all the load fluctuations of the plant were taken up by the steam turbine, and the reciprocating units went on carrying almost constant load, whilst the turbine load fluctuated between 0 and 8,000 kw. in periods of less than 10 seconds.

"The combination of gas engines and steam turbines in a single plant offers possibilities of improved efficiency whilst at the same time removing the only valid objection to the gas engine.

"A steam turbine unit can easily be designed to take care of 100 per cent. overload for a few seconds; and as the load fluctuations in any plant will probably not average more than 25 per cent., with a maximum of 50 per cent. for a few seconds, it would seem that if a plant were designed to operate nominally with 50 per cent of its capacity in gas engines and 50 per cent. in steam turbines, any fluctuations of load likely to arise in practice could be taken care of."

In addition to the question of care of overload, made possible by the combination of the gas engine and the steam turbine, this arrangement renders it possible to utilize some of the heat rejected by the gas engine in connection with the steam plant. Thus the jacket water of the gas engine, discharged at a temperature above 100° is available as feed water, while the heat in the exhaust gases can be utilized either in economizers or directly in boilers or superheaters. Summing up, Mr. Stott makes the following points as worthy of consideration in the design of power plants:

"The present type of steam-power plant can be improved in efficiency about 25 per cent. by the use of more scientific methods in the boiler room, by the use of superheat, and by running the present types of reciprocating engines high pressure, and adding a steam turbine in the exhaust between the engine and the condenser. At the same time the output of the plant can be increased to double its present capacity at a comparatively small cost for turbines and boilers.

"The steam-turbine plant has an inherent economy 20 per cent. better than the best type of reciprocating-engine plant, not so much due to its higher thermal efficiency as to a variety of other causes.

"An internal-combustion engine plant in combination with a steam-turbine plant offers the most attractive proposition for efficiency and reliability to-day, with the possibility of producing the kilowatt-hour for less than one half its present cost."

METHODS OF COST ESTIMATION.

THE PRELIMINARY DETERMINATION OF COST AND SELLING PRICE OF ENGINEERING AND MANUFACTURED PRODUCTS.

A. W. Farnsworth—Coventry Engineering Society.

MUCH has been written and discussed about methods of cost-keeping, both as to the determination of time and material and to the general expense distribution in manufacturing businesses, but nearly everything which has been published in this line has been devoted to the finding of the costs of completed articles. The converse problem, that of estimating the probable cost of an article yet to be made, is a question which has to be answered daily in many large establishments, but there is comparatively little public information to be had about it, and from the wide discrepancies which appear in simultaneous bids upon identical undertakings it is evident that the practice of leading firms is not harmonized. An interesting paper upon the subject of the estimation of costs was recently presented before the Coventry Engineering Society by Mr. A. W. Farnsworth, and some abstract and review of his treatment of an important question is here given.

"The increased severity of competition in the engineering trades has automatically compelled the attention of manufacturers to be directed most seriously to their estimating departments, and of late much has been printed and said on the matter by both interested and outside parties. For every job in the market there are now several—in some cases dozens—of competitors, any one of whom is able successfully to undertake it, and the natural consequence has followed; prices have been gradually cut and cut until in many cases profits have completely vanished. But when a man or a company owns a works in which a great deal of capital has been placed, it is necessary that a turnover be secured, otherwise the dead charges alone will soon bring banksuptcy, and modern specialisation has been directed towards, on the one hand, reducing costs in the works, and towards, on the other hand, gaining a finer and truer appreciation of those costs in the office. Yet, notwithstanding all that is already known of these things by the heads of our establishments, all that has been written, and all that has been published, the quoted prices for engineering work to-day based on the same drawings, specification and information—stand as evidence that we have as yet barely touched the fringe of the subject, that we are still very much in the 'guessing' stage, and that scientific methods of estimating remain in embryo."

Mr. Farnsworth gives some examples to show the crudeness of the methods adopted in practice, citing nine sets of estimates upon three different jobs. Upon the first job there was a difference of nearly 115 per cent. between the lowest and the highest bidder; on the second more than sixty per cent., and on the third about twenty per cent., the first example being the smaller value and the third on a piece of work more than ten times as large. There is no indication whatever that all the estimators upon these jobs were not perfectly honest, and doubtless the actual cost of the work would have varied somewhat in the different shops, but such discrepancies as appeared can only have been caused by defects in the methods by which they were determined.

"It is curious to the onlooker to note the different methods of the average estimator. No two men will perhaps approach any one job in the same way. Some men lump, others minutely dissect, others again try the halfway house; yet all desire the same end—accuracy. Often past costs are turned up and efforts made to apply the figures found, but only those who try know how often this ends in wholesale rejection of the old figures and the substitution of empirical ones. Of course, when an article is standardized—such as a 12-in lathe or similar tool—and prices are fixed, these remarks have not the same force. In such cases the old figures are used over and over again, and some semblance to accuracy is found; but estimating as a science is misapplied to multiples of the same thing; its true scope is only found when every new job differs from every old one, or when a totally new

pattern of an old tool is being introduced. Generally speaking, the old-style estimator looks at a drawing and endeavors to frame in his mind a picture of what he sees and to allocate the whole into a particular division or class; thus, if it be a new pattern of twist drill, he will mentally compare it with other patterns and put it in the same class as the pattern it most nearly resembles; when he has succeeded in doing this he is persuaded in his own mind that he knows exactly what it will cost, and down goes the price in a lump sum. Sometimes he is wrong, sometimes right—anyhow, he has but attempted a shrewd guess, and this is not science. The new-style estimator has a very different way. He produces records of the costs of past work, figures worked out to two or three decimal places, searches his file for verification of turning, cutting, millling, and other prices, turns up the actual cards of the several jobs and extracts lots of information—what for? To hatch new figures which will be applicable as nearly as he can tell to the new work. The different decimals are added together, and a result presumably accurate to the hundredth part of a penny is produced; the real net result being, however, only another form of guesswork. The new style is science, yes, but misapplied.

"There can be small doubt that ideal estimating consists in minute dissection and gradual building up of the total price from an aggregate of properly considered minor operations. There is neither no question that accurate costs of previous work are essentials to any success. We can subscribe to this without further argument. Estimates, whether of machine tools or bridges, should be built up in very much the same way as a builder arrrives at his lump sum price—from a bill of quantities with each item carrying its allotted and proved sum. It is, however, to be hoped that while the system itself is followed the results will be more authentic than the average builder's tender. The connection between costing and estimating is most intimate—in fact, seventy-five per cent. of the necessity for incurring expense in costing is due to the exigencies of the estimator, and with a view to future work, the other twenty-five per cent. being taken up with the desire of seeing that the work does not exceed its estimate, and of checking its progress and arranging that by hook or by crook it shall come within the estimated figures. The estimator is nothing without his costs, and it follows that the prime necessity of his being is that his costs shall be reliable. How to make them so is what everyone interested in the question is trying to solve to-day. Many men pin their faith on some particular system of keeping accounts, some novel ruling of ledgers and cost books, or a certain size and configuration of a card; now, while one certain method of keeping figures in juxtaposition may be admittedly better than some other method, it is utterly vain to expect that accuracy and reliability will ensue because of the method. Whole storerooms full of figured papers may well result from the system, and any little part of the whole may be instantly accessible; but unless the little part when found is actually reliable, it is of small use except to look at; it is a monument to great, painstaking, and intelligent arrangement of detail, but it is useless as a fact.

"Hard facts are what the estimator wants—more or less accurate approximations are what he usually gets."

One important element in the accurate determination of values for estimates is the opportunity which is given to the estimator to become familiar with the actual cost methods in the shop. In many large establishments the estimating and the costing departments are carefully separated, and the men in one department are not permitted to know anything about what is being done in the other. This is absurd and cannot but impair the usefulness of the estimates, since accurate estimating depends upon good costing, and the two departments should be operated in harmony and cöoperation. Mr. Farnsworth himself believes that the estimator and prime coster should be combined in the same individual, and that he should not be compelled to look at totals worked up in another department by any process imaginable for his information as to how things have gone. He should see the whole makeup of these totals, and by living in them and with them he will imbue the spirit of them and be able to see in what way and for what reasons items and processes may be altered or modified. Such

a man should possess first-class engineering knowledge, keen business perceptions, and abundance of tact. The material from which he may be developed may be found in many men now occupying subordinate positions, and when such a post is created there should be no lack of men to fill it.

The only correct way in which a proposed piece of work can be estimated is by a minute dissection of the whole into its parts. The cost of patterns must be determined by a comparison of estimates by the patternmaker with actual costs of similar work already made, checked by the personal knowledge of the estimator. An important element in this and all other parts of the question is the determination of the time required, not only because of the point of time of delivery, but because expense charges are largely dependent upon time. Foundry costs must be based in like manner upon actual data from similar work, the estimator making careful allowances for dead charges, for the influence of other work in hand, and for the quantity and quality of material required. It is grossly unfair to take either the wage costs of the weight turned out and lump on a never-varying percentage obtained from the average of a year's working. Each particular job should stand its own expenses as nearly as scientific methods can make it, and here accurately kept costs will be of incalculable advantage.

"By the time the foundry has turned out the castings the machine shop has to take them, and here again very careful work is necesssary. The foreman should be taken into confidence and help in the framing of the machining costs. Every piece must be considered and labor expense detailed; the machines available and the other work in hand will want taking into account, as also the probable demand on the motive power, the time the job will be about, the handling it will take, and the attention to be given by the cranes, the space it will take up, and the laborers' time it will absorb. Every single factor entering into its composition as a job will require thinking about. Similarly, in the erecting shop, and again in the testing and proving yard. Nothing can be neglected; everything must be considered, and have its place. Is this, then, work for clerks untrained in the love of the shops? Can it be safely left to the perspicuities of the different foremen only? It demands and should have a master mind."

THE AUTOMOBILE OMNIBUS IN PARIS.

PLANS OF THE GENERAL OMNIBUS COMPANY OF PARIS FOR THE INTRODUCTION OF AUTOMOBILE VEHICLES FOR PUBLIC SERVICE.

Lieut.-Col. G. Espitallier—Le Génie Civil.

ALTHOUGH the construction of the underground railway in Paris, and its continual extension, in accordance with the general plan, to many parts of the city has caused an active competition with the omnibus system, no serious attempt has been made until very recently to meet this competition. In some portions of Paris omnibus lines from which a large portion of the traffic has been diverted have been discontinued, but on the whole an extreme conservatism has been shown in dealing with the question of improved transport on the surface. Meantime other cities have shown activity in the improvement of methods of surface transport, and in London the automobile omnibus has made greater advance in public favor than in France, notwithstanding the success which has attended the development of other types of automobiles across the channel.

In a recent issue of *Le Génie Civil* an account is given by Col. Espitallier of the difficulties which have been in the way of the automobile omnibus in Paris, and the plans which have been made to overcome the obstacles which have deferred the advent of such vehicles on the streets. An important element in the supercession of the horse by the machine is that of operative cost, and in this respect London, under different fiscal conditions, has a great advantage over Paris. Thus the essence which constitutes the most suitable fuel for such vehicles costs only seventeen francs per hectolitre in London, while in France the price is increased by ten francs for duty, and in Paris by twenty francs more for

the *douane*, or municipal tax, the selling price being forty-seven francs fifty centimes per hectolitre. For the 300 omnibuses operated by the Paris company this means a cost of 2,500,000 francs per annum greater in Paris than in London. At the same time the municipal authorities of Paris are more interested in the development of new systems of transport, such as the electric service of the Metropolitaine, than in any reduction of the *douane*. There is, therefore, in Paris a necessity for the demonstration of the actual operative efficiency and economy of the automobile omnibus before a company such as that controlling the Paris omnibus system can feel justified in making the change from animal or mechanical power, with all the investment outlay which it involves.

During the recent road trials between Paris and Havre, already reviewed at length in these columns in November of last year, some valuable data as to the performance of automobile omnibuses were obtained, but in addition to these results the *Compagnie Générale des Omnibus* decided to institute further trials, and hence invited a number of eminent builders to submit such vehicles to a series of identical trials. As a consequence of these investigations a regular service was started between the Bourse and the Pont d'Alma and maintained during the month of December, at the time of the Automobile Salon, with much success. The time for the traverse of the course was nineteen minutes, which, with a stop of five minutes at each terminal, makes forty-eight minutes for the round trip, and this schedule was maintained with perfect regularity. Col. Espitallier gives descriptions of the various vehicles which were submitted for trial, with data as to their performance, and the information thus gained should prove of general engineering value and interest.

There is a general similarity in appearance in the different machines, this being due to the fact that each manufacturer furnished his own chassis, while the bodies of all the vehicles were supplied by the omnibus company from standard patterns. As a matter of fact, it does not appear that any of the machines were especially designed for the special service in the streets of Paris, the running gear in each case being that already devised for trucks and lurries for the transport of merchandise, the omnibus bodies being mounted upon the chassis to convert these vehicles into passenger omnibuses. Nearly all of the machines submitted for trial were operated by internal-combustion motors connected to the driving axles by gearing, but among them were some using electrical transmission, the motor driving a dynamo feeding electric motors on the axles, this system giving great flexibility of control, necessary in the crowded streets of a great city, while one vehicle used the Serpollet system, involving the steam boiler of the instantaneous flash type and the steam motors associated with this design.

Reference must be made to the original paper for illustrations and descriptions of the various machines subjected to test, but some of the conclusions may be given here.

In general, it appears that motors running at speeds of not more than 300 to 900 revolutions per minute are better adapted for omnibus service than those running at higher rotative speeds. In view of the occasional steep grades to be overcome, it has been thought advisable to provide from thirty to thirty-four horse power, the omnibuses themselves weighing from four to five tons, in addition to the weight of thirty passengers and the conductor. Experience in the Paris-Havre trials, as well as the results obtained in service in the streets of Paris, show that the cost of fuel is about twenty centimes per kilomtre.

One of the important elements in the operation of automobile omnibuses is the question of tires. The various machines submitted in the trials were equipped with tires of various types, among which may be noted the solid tires of the Ducasble type and the Français tire, composed of separate blocks of rubber. It has been estimated that the cost for the maintenance of the tires will reach 10,000 to 12,000 francs per year for a vehicle in regular service, an important element in the matter of operating costs, and one which may well occupy the interested attention of inventors and investigators.

The question of substituting mechanical traction for animal power in the streets of great cities is one which may well occupy the attention and efforts of engineers and

capitalists. Rapid transit is essential when the dimensions of large cities are taken into account, and while it is probable that underground railways at high speed will carry the bulk of the long-distance traffic, there will always be a demand for prompt and efficient transport for moderate distances on the surface. The time is doubtless approaching when the presence of the horse must be prohibited as an unhealthful nuisance in the modern hygienic city, and this means that the mechanically propelled vehicle must be prepared to meet the emergency.

FIRECLAYS AND MOULDING SANDS.

THE NATURE AND PROPERTIES OF REFRACTORY MATERIALS IN PRACTICAL USE IN FOUNDRY OPERATIONS.

Percy Longmuir—British Foundrymens' Association.

IN many ways there is encouraging evidence that the foundry is rapidly rising to a position fully equal, from a scientific point of view, to that held by other departments of industrial technology. The rule of thumb, and the predominance of empirical methods are giving way to the processes of the laboratory, or rather to practical methods derived from correct scientific principles, and the results are already most encouraging.

In a paper recently presented by Mr. Percy Longmuir before the British Foundrymens' Association the requirements of the foundry as regards refractory materials, both for furnace linings and for moulds, are discussed, and this very practical subject is treated in a thoroughly scientific way.

Since the function of refractory materials is to resist a high temperature it is essential to have some definite knowledge of the actual temperatures occuring in different departments of foundry work. In furnaces these temperatures range from about 1,200° C., in a crucible for brass, up to about 1,800° C. in the open hearth steel furnace. In the ordinary cupola it may be taken as from 1,500° C. to 1,600° C. The temperatures in the moulds naturally vary, according to local conditions, but run somewhat lower than furnace temperatures. For aluminum the mould will attain a heat of about 690° C., while for gun metal it will run over 1,000°. For white cast iron the temperature in the mould is given at 1,230°, and for grey cast iron 1,350° C. Steel runs still higher, ranging from 1,500° to 1,600° C. An examination of the temperatures, therefore, gives an indication at once as to the requirements for linings and sands.

"Chemically, refractory materials vary, but usually contain silica, alumina, lime, magnesia, oxides of iron, or manganese, alkalies, soda and potash, etc. Silica, alumina, or lime, are alone very infusible, and will resist the highest temperatures attainable in foundry practice. However, for various reasons these materials cannot be used in a state of purity. The softening point of silica may be taken as about 1,830 degrees C.; alumina and lime are probably higher. But the three compounds which separately are extremely infusible may, on admixture, become more fusible. Boudouard, who has examined this matter from the point of view of slags, has arrived at a series of interesting results. Thus, silica softens at 1,830 degrees; if this silica is associated with 14½ per cent. alumina, the softening temperature is reduced to 1,690 degrees. Further increments of alumina and corresponding decrease in silica result in gradually raising the softening temperature, until at 37 per cent. silica and 63 per cent. alumina a softening point of 1,890 degrees is reached, which is some 60 degrees *above* that of silica."

With mixtures of silica and lime, giving rise to silicates of lime, the softening temperature falls from that of pure silica, until the proportion of silica becomes 60 per cent. and lime 40 per cent., after which, with the increase in the proportion of lime the softening temperature rises again. Triple combinations of silica, alumina and lime are comparatively fusible, falling below 1,400° C., or lower than some of the mould temperatures in the foundry.

The resistance to heat is but one of the properties which should be possessed by a furnace lining or a moulding sand, and it

is connection with the working qualities of a refractory material that practical experience in the foundry must be taken into account.

"Furnace linings have, in addition to high temperatures, to resist one or more of the following conditions:—(1) Expansion and contraction, due to alternate heating and cooling; (2) the cutting action of flames, the abrading effect of molten metal, and the searching action of metallic oxides or scouring slags; (3) reducing or oxidising atmospheres in the furnace; (4) mechanically the lining must withstand the wear and tear of charging solid metal. With regard to the action of slags, we have already seen that silica and lime, when in contact at elevated temperatures, unite and form a silicate which fuses at a comparatively low temperature. Therefore, if the lining of the furnace is siliceous and the slag contains much lime, this lime will unite with a portion of the silica of the lining and form a fluid slag."

Mr. Longmuir divides refractory materials into three classes: acid, neutral, and basic. The acid materials contain an excess of silica which, acting as an acid, will combine with various bases to form a fusible silicate. Silica sand, containing 94 to 96 per cent. of pure silica, is very infusible, and is employed to form the bed of the open-hearth furnace. Since this sand possesses no bond it cannot be rammed into any permanent shape, in when used for the bed of a furnace it is applied in successive layers, each layer being fritted, or raised to such a temperature that it becomes slightly fused.

When it is necessary to use a siliceous material in a definite form, some such material as ganister, containing from 90 to 95 per cent. of silica and the balance clayey matter, is employed, this when ground, being capable of ramming into form for lining cupolas, Bessemer converters, etc.

Basic refractory materials are not very extensively used in the foundry, as they are not so readily manipulated as acid linings. They are used only when the slags of the process are of such a character that they eat into, or unite with an acid lining. The commercial basic materials used are composed of lime or magnesia or a combination of the two. Neutral materials find application as intermediate layers between the acid and basic portions of a furnace. Such neutral materials are chromite, carbon, or most frequently, fireclays. Fireclays are essentially hydrated silicates of magnesia, containing, before burning, 46.5 per cent. of alumina, 39.5 per cent., combined water 14 per cent. The presence of the combined water produces the plasticity of the clay, and after burning this water is wholly driven off. Impurities may be present in the form of magnesia, lime, oxide of iron, and alkalies, and in any case the alkalies should not exceed more than 1 per cent.

Considering moulding sands, these have to resist heat, furnace atmosphere, and the action of liquid slags and metals. If resistance to heat were the only property necessary the value of a sand might be determined from its chemical composition, and be considered as dependent upon the content of silica.

"A consideration quite apart from temperature is, however, found in the *searching* action of liquid metals. It can be taken as an axiom that the greater the fluidity, the greater the penetration into the mould. For example, we may take a series of moulds, prepared from one batch of sand, all equally rammed, and all in the same condition as regards moisture, but none of them faced. We will assume that the sand is in a moderately fine state of division, such as would be usual for a cast-iron mould, and that it contains 84 per cent. silica. Into one mould fluid cast iron is poured at a temperature of 1,350° C. A certain amount of sand will stick to the cold casting, but it will permit of removal by a wire brush. Into another mould mild steel, at a temperature of 1,600° C., is poured, and from the cold casting adhering sand will not permit of removal by a wire brush. It will, in fact, have fused into a silicate of a more or less glassy nature, and will require chipping off. This is purely a temperature effect, but turning to the other extreme, and taking an example from lead, it will be found that a casting poured at 400° C. will come out with a perfectly smooth skin. If another casting is poured at 675° the sand will adhere most tenaciously and the casting be full of veins. The adhering sand will give every appearance of being burnt—if not actually fused—yet the temperature is only half that of cast

iron, which at 1,350° would yield a smooth casting. Although not actually a fusion of the sand into a silicate, the difficulty in dressing the casting is as great. Probably the most common example of searching is found in phosphor bronze, which at a normal temperature is extremely fluid, and will penetrate into the pores of a mould, binding the individual grains of sand into a dense and compact mass—a fact very familiar to brass founders, and one readily appreciated by the dressers.

"Therefore, in certain cases, a moulding sand must resist, not only temparature, but also the penetrating action of a thinly fluid metal or alloy. Of necessity, this latter property must be associated with porosity in the sand. Could an impervious mould be used there would be no difficulty in arresting penetration. However, the substance of the mould must be of such a nature as to offer a free escape for the gases generated on casting. Further, the sand, when rammed into shape, should be firm to resist liquid pressure, and strong to resist the washing action of a stream of molten metal. These do not constitute all the desirable features of a sand; incidentally it should give a clean, smooth skin to the casting and be readily removed from it.

"Reverting to the chemical composition of sands, they are found to contain—in addition to silica—varying amounts of alumina, magnesia, lime, and metallic oxides. Alumina increases the cohesion of a sand—that is, its binding qualities—but at the same time it destroys porosity. Lime and metallic oxides, if in excess, increase the fusibility—hence, destroy heat-resisting properties. Soda and potash are equally harmful in this respect, but they are not usually present in dangerous quantities."

AMERICAN COKE MAKING.

RECENT DEVELOPMENTS IN COKE PRODUCTION IN THE UNITED STATES TO MEET PRESENT AND FUTURE REQUIREMENTS.

Edward W. Parker—Iron Age.

IN the iron and steel industries in the United States there has been such a great productive activity during the past year as to influence to a marked degree such other lines of industry as bear any relation to the iron manufacture. Thus the production of coke in the United States during 1905 exceeded that of any previous year, all the old regions having been pushed to their maximum capacity, while new areas of coking coal have been developed. This whole subject of coke making in the United States is treated in an article in a recent issue of the *Iron Age,* by Mr. Edward W. Parker, of the United States Geological Survey, from which some abstracts will be found of interest, as bearing directly upon the iron and steel industry.

"It is an open secret that at the present rate of production the Connellsville basin will be exhausted in from 25 to 30 years, and even this brief term of life will be shortened by an increasing drain upon the reserves. The Connellsville basin is estimated to have contained originally 137 square miles, or 87,700 acres, of the Pittsburgh bed, which here has an average thickness of about 7 feet. Estimating 1,100 short tons to the foot acre and a recovery of 90 per cent., which is said to be attained, the total available supply when production began was about 600,000,000 net tons. About one-third of the coal has already been worked out, so that, say, from 55,000 to 60,000 acres, or approximately 425,000,000 net tons, remain unmined. During the last five years the coke production of the Connellsville region has averaged 10,000,000 net tons, equivalent to 15,000,000 net tons of coal. At this rate, exclusive of any of the coal sold or used at and near the mines in operating the properties the entire bed will be exhausted inside of 30 years.

"But while Connellsville coal is the ideal coking coal particularly for beehive ovens and although this region has for many years produced over 50 per cent. of the total coke product of the United States there is no reason why ironmasters and other coke consumers should feel any apprehension as to their supplies of fuel when Connellsville coke shall have ceased to be a factor in the trade. There are still large

areas of good coking coal lands practically untouched throughout the Appalachian field and the active development which has been in progress during the past year in the other coke producing regions indicates that provision is being made for future requirements."

Mr. Parker reviews the development of other regions in Pennsylvania, and also in West Virginia, with an excellent map, and he also refers to the existence of fields in Kentucky, where vast areas of high grade coking coals are only waiting for railroad facilities to be placed in the market.

Apart from the sources of coking coal, and important question at the present time is the introduction of modern by-product coke ovens, and the utilization of the gas by pipe-line transmission to more or less distant places.

"As a producer of illuminating gas the by-product coke oven has steadily gained ground. The method of separation of gases is now generally recognized as the most advantageous system. This consists in dividing the gas evolved from the coal into two portions, the first part being of higher illuminating and calorific value, known as the "rich" fraction. The second portion is of lower quality and is known as the "poor" or fuel portion. It is used for heating the ovens, which by their construction are necessarily heated by gas, though not necessarily by their own gas. The rich gas is available for illuminating or other purposes and comprises from 30 to 50 per cent. of the total volume of gas obtained from the coal, varying with the quality of the latter. Compared with ordinary coal gas it is usually of equal or better illuminating and calorific value, although not made from gas coals, this being due to the method of fractional distillation, by which only the best of the gas is taken.

"One handicap to the advantageous disposal of by-product coke oven gas has been that where ovens have been built for supplying coke to blast furnaces the immediate vicinity of the plant did not have population enough to absorb the disposable gas. Under such circumstances the long distance transportation of gas in pipe lines under pressure has come into use.

"Gas from by-product coke ovens at the plant of the Maryland Steel Company at Sparrow's Point, Md., is now regularly pumped to Baltimore through a pipe line about 9 miles in length under a pressure of approximately 5 pounds and under all weather conditions. Between 4,000,000 and 5,000,000 cubic feet per day is thus delivered to Baltimore, forming a large portion of the total illuminating gas consumption of that city.

"Gas from the by-product ovens of the South Jersey Gas, Electric & Traction Company at Camden is now regularly pumped through pipe lines to Trenton, N. J., a distance of 38 miles, under an initial pressure of about 10 pounds. This is accomplished without any appreciable drop in the illuminating value of the gas after transportation, even under extreme weather conditions.

"The Camden plant is also notable as being the first to install the process of gas enrichment by benzol transfer on a large scale. This process has been developed by the United Coke & Gas Company and consists in removing the benzol from the 'poor' or 'fuel' fraction of the gas by scrubbing with tar oil. The benzolized oil is then subjected to fractional distillation in a still through which a current of rich gas passes and the highly benzolized gas is mixed subsequently with the main volume of 'rich' or illuminating gas, thus adding to the illuminating power of the latter by some 4 or 5 candle-power. As the enrichment is made by practically pure benzol it is said to be permanent in its character at the temperatures and pressures prevailing in a gas distribution system; the enriched gas therefore reaches the consumer with all of its illuminating value. The process also possesses advantages because of the simplicity and low operating cost of the apparatus, and as it uses the benzol already at hand the enrichment is obtained for practically the nominal operation charges.

"In the construction and operation of the by-product oven the advances made have been of a minor character, affecting the details of the process. The oven capacity has been gradually increased, the dimensions added to being those of height and length rather than width. The process of compressing the coal into a cake, which is charged into the oven in one piece through the end instead of filling the loose coal in

at the top charging holes, has not grown in favor, principally because of its high cost of installation, slow operation and the trouble with freezing in winter.

"Numerous improvements have been made in the machinery accessory to the by-product ovens, among them being a new form of coke quencher, in which the coke is quenched and loaded into cars by one man, the quenching water being applied in a closed receptacle, so that the silver-gray color of beehive coke is reproduced and at the same time excessive moisture in the coke is avoided."

The by-product coke ovens at present used in the United States are of the Otto, Otto-Hoffman, and Semet-Solvay types, and there are now built and under contract 2,380 United-Otto ovens and 1,255 Semet-Solvay plants, so that it is evident that the by-product coke oven is making rapid headway in America.

IMPACT TESTING.

THE STUDY OF THE RESISTANCE OF MATERIALS TO SHOCK BY THE DROP TEST UPON NOTCHED BARS.

Capt. H. Riall Sankey—The Engineer.

DETERMINATIONS of the resistance of materials of construction by subjecting specimen pieces, representing more or less correctly the larger quantities actually to be used in construction, are now very general, and the large amount of study which has been given to this subject entitles it to be considered as a distinct department of engineering research. Formerly it was considered sufficient to determine the ultimate tensile resistance of most materials, and even yet there is a disposition to reduce many other properties to functions of the tensile strength, and thus deduce values which are much better determined directly. Especially has there appeared of late a tendency to introduce dynamic tests, as auxiliary, at least to the static tests which preceded them, and in view of the shocks and vibrations to which actual structures are subjected, some direct knowledge of the behaviour of materials under shock is most desirable.

Drop tests, such as those made upon railway axles, and similar products, have long been used, and these have the material advantage that they are made upon piece representing the actual finished product. Such tests, however, include the delivery of many blows upon the piece, and involve a large apparatus, take much time, and do not give all the information which is desired. For this reason there has been applied of late another method, using small test pieces, usually with a nick or notch in the surface of the metal, to localize the action of the blow, the size of the piece and the weight and height of the drop being so chosen that the test piece is fractured by a single blow. By measuring the energy in the falling weight before and after the fracture of the test piece the quantity of energy required to effect the break may be accurately computed, and definite and quantitative information thus secured. This method is analogous to that sometimes employed in studies of the resistance of armor plate, the test plates being made thin enough to insure that the projectile shall pass clear through, this permitting the use of the chronograph for the measurement of the velocities of the shot just before impact and immediately after penetration, the resistance of the plate being thus measured by the retardation produced upon the velocity of the projectile.

In a recent issue of *The Engineer*, Captain H. Riall Sankey examines the practical uses of the one-blow drop-test system as a means of determining the properties of various steels, and shows the advantages of the system in connection with the resistance of such materials to shock. Captain Sankey does not believe that the shock test alone is sufficient to give all the desired information about a material, however, but insists that a tensile test, or its equivalent, should also be made.

The fundamental difference between impact testing and statical tests is that in the former case the elastic stresses of the material are necessarily exceeded, and in the one-blow method there must be an excess

of energy to insure that the breaking stress be reached; this, in reality, being the essence of the method.

"In the many-blow method the elastic stress must be considerably exceeded if the specimen is to be broken with a reasonable number of blows; and it is further evident that the amount of this excess will very greatly affect the number of blows. From the standardisation point of view a difficulty of the many-blow method is thus made apparent, for obviously it will be difficult to co-ordinate the results of machines having different energy in the blow, and different sizes of specimens combined with varying strengths of steel. Suppose, for instance, that a certain specimen breaks with twenty blows when the elastic limit is exceeded by 20 per cent., how many blows would be required if the energy of each blow were reduced so that the excess were only 5 per cent.? No doubt a far greater number of blows, but how many more it is difficult to say."

The use of a notch in the top of a test piece, at the point where the blow is delivered, has two effects; making the rupture of the piece with a single blow more certain, and especially revealing tendencies to brittleness which might not otherwise appear. It has long been known to the shop mechanic that a bar which could be bent over the edge of the anvil by several blows, would break off short with a single blow if first notched with a file, the fracture in the latter case often appearing granular and quite different to the fibrous nature of an ordinary bending test. The realization of this fact leads every careful designer of machinery to avoid sharp angles and corners in parts subjected to vibratory or sudden stresses, and hence a similar course of reasoning indicates that the behaviour of the material under just such conditions is a good thing to investigate. Many mild steels, which appear ductile under tensile stress are in reality brittle under shock, while it may well be accepted that a material which shows up well under the drop test with a nicked bar is a desirable substance for use in structures subjected to vibration.

"It will probably be conceded that owing to the suddenness of the rupture with the one-blow method with notched test piece that there is insufficient time for the molecules to become displaced, and that therefore the fracture is an index of the molecular, or, perhaps, more strictly, of the molar structure of the steel, and this in itself is a most valuable feature of this method of impact testing, and the writer has no hesitation in saying that the appearance of the fracture is of the greatest assistance in deciding on the quality of the steel. This statement is undoubtedly also true of the fractures obtained with the many-blow method, but the difference between the various fractures is not so well marked, and the fracture cannot well represent the actual fracture of the steel, because the molecules will have time to become displaced, and the final structure will be that due to the modification of the structure of the steel produced by the effect of the successive blows. It is not difficult to conceive that owing to some particular heat treatment the molecules of a steel of good composition may be so arranged as almost, but not quite, to form a structure capable of resisting shock. The structure may, in fact, be in a condition of partial unstable equilibrium, which would be upset by a blow; thus the steel would be in a brittle condition, and would break readily if subject to a blow of sufficient magnitude, as would be the case if tested by the one-blow method. A small blow, however, might have the effect of slightly displacing the molecules and bringing them nearer to the positions required for a structure capable of resisting shock. In the case thus conceived the effect of the successive small blows of the many-blow method of impact testing would be gradually to improve the structure of the steel so that it would resist a great number of blows, and would appear to be of good quality."

Captain Sankey tabulates data and results of a number of tests upon steels of different kinds, giving the heat treatment and results of tensile tests, together with the behaviour of the same materials under the single blow drop test, and shows how the latter system enables the materials to be classified into groups denominated respectively brittle, tough, and very tough, enabling selection to be made in accordance to the use to which the material is to be applied.

OUTSIDE WORK BY ENGINEERING PROFESSORS.

THE POLICY OF PERMITTING THE CONDUCT OF INVESTIGATIONS AND COMMERCIAL TESTS IN CONNECTION WITH THE WORK OF AN ENGINEERING COLLEGE.

D. S. Jacobus—American Association for the Advancement of Science.

FOR a long time there has been a difference of opinion among technical educators as to the propriety or desirability of the undertaking of outside and private scientific investigations by college professors. The trustees or governing bodies of educational institutions have, in the great majority of cases, held that the institution is entitled to the whole time of the instructor, and that any attention given by him to work other than the direct tuition of students is that much effort diverted from the work for which he is paid by them. Of late, however, it has been realized that there are two sides to this subject, and at the present time the practice is by no means uniform in all institutions, although many people who have to do with the matter hold very decided opinions upon one side or the other. For this reason the thoughtful address, delivered by Professor D. S. Jacobus, as vice-president of the American Association for the Advancement of Science, and chairman of the section devoted to mechanical science and engineering, is to be welcomed. The address is published in a recent issue of *Science*, and from it we take occasion to review some of the salient points.

Professor Jacobus assumes at the start what few will now be inclined to dispute, that a professor in any department of applied science should have a practical as well as theoretical acquaintance with the subject which he has to teach. This practical experience may be acquired in three ways: by having been a practical man, in active exercise of his profession before undertaking work as a professor; by interpolating, so to speak, a period of active practice between two engagements as a professor; or, by carrying on practical work simultaneously with his professorial duties.

As Professor Jacobus remarks, each method possesses its own advantages and disadvantages. Undoubtedly many able instructors have gained their experience in the practical field before entering the teaching profession. A notable example in this case is found in the late Professor Reuleaux, who, after a thorough technical and literary education, entered the machine shop, and rose to be a manager before becoming a professor at Zurich. At the present time such a method is not common, largely because a man of sufficient ability to fill any important professorial chair can make a far greater reward in the practice of his profession than the salary paid by educational institutions, besides which it is difficult for a man who has matured in the practical field to adapt himself well to theoretical methods. The same difficulties which prevent the general adoption of the first plan also appear in the second. A professor who enters the practical field may well acquire the experience which would fit him still better for his work as an instructor than formerly, but in the great majority of cases he finds the new field so much more profitable than the old one that he has no desire to return.

There remains then the third method, that in which the professor undertakes outside professional work, in parallel, so to speak, with his duties in instruction. That there have been objections to this method is a well-known fact, but such objections do not appear to be altogether well founded. If a professor neglects his work of instruction for the conduct of outside professional work he is certainly not the man for the chair which he neglects, but such instances are few. A professor who is energetic enough to take upon him the additional labor of outside work is apt to be a worker in everything. As Professor Jacobus says: "The professor must exert himself to the utmost to secure the best results with his students and when this is done, there is no harder way than by the undertaking of outside work, and if the professor is an enthusiast there is often much danger of his breaking down under the strain. On the other hand, if he manages to secure an experience which will give him the reputation of being an author-

ity in his field, he usually will make the best sort of a teacher, and be a credit to the college with which he is connected."

"In all that has been said so far it is assumed that it is necessary for certain professors to have an experience in the outside field. I do not think any one will question this. One is apt to get into a rut in teaching and to have his mental horizon narrowed so that he cannot perceive his own faults, and there is no better way of expanding this horizon than to be a coworker with practical men. The main advantage that a practical teacher has over one who is purely theoretical is that he can make his course interesting by the introduction of practical examples, and in this way incite the students to study intelligently, which is the real measure of his success. He may, however, make the mistake of introducing too many practical details into the course. It is essential above all that the fundamentals of the subject shall be mastered, and the true use of practical problems, aside from securing the interest of the class, is to show that their solution is based on a few broad underlying principles. A practical man may also make a mistake in thinking that his way of looking at a problem is so simple and straightforward that it will surely be grasped by the students. In teaching, however, he will find that after presenting a subject in what he considers a way that all must understand, there will be many, possibly the majority of the class, that have failed to grasp the reasoning. Men's minds work differently, and the path taken to arrive at the understanding of a problem will vary, so that unless a subject is presented in several ways the explanation given by a professor may fail to fall into the line of thought of many of his students, and he will be disappointed in the results obtained.

"It is a fact, however, that there are many professors who have had little or no outside experience. This often occurs where a young man enters the profession of teaching directly after his graduation, and is placed in such a position that it is impossible for him to undertake any practical work. Such a professor may make the best sort of a tutor, and may be most successful in imparting the fundamentals of a subject, but when it somes to being put in charge of a practical engineering department, it is here that his lack of experience will be very much felt. In a certain sense it is unfair for a head professor to secure the services of a recent graduate and keep him continually at teaching so as not to allow him to gain outside experience."

There is one point about this matter of outside work by professors which is not always considered by trustees and others who object to the practice. If a man is so highly esteemed by business men and others who are obliged to secure professional advice and assistance that his aid is sought, he must be a man of superior attainments and ability, and the educational institution may well deem itself fortunate to secure his services at all. The old law of supply and demand asserts itself here as elsewhere, and the man who is wanted by nobody else is not likely to be the best man for the professor's chair. The educational institutions must permit their abler professors to keep themselves up in the active practice of their professions, or else face the certainty of losing them altogether.

"It has been claimed that the professors of an engineering college should not do work in the practical field, as this interferes with the consulting engineers who depend for their livelihood on just the sort of work that would be apt to be undertaken at a college. This is a very narrow view to take of the matter, and as far as my own personal experience is concerned, I can testify to the fact that much of the work undertaken in connection with my college duties has been done for consulting experts. The day is past when there can be a strict line drawn between the work of the consulting engineer and that of the professor who teaches in the same field. The ideal professor in a given line should be able to take up the work of the consulting engineer in that line, and the ideal consulting engineer should possess enough technical knowledge to fit him for being a professor. There should be no jealousy, but rather a bond of friendship in that the fundamentals which each should master are the same."

THE ENGINEERING INDEX

THE KEYSTONE
IN THE ARCH OF APPLIED SCIENCE

The following pages form a **descriptive** index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

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The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full titles of the principal journals indexed are given.

DIVISIONS OF THE ENGINEERING INDEX.

Civil Engineering	917	Mechanical Engineering	933
Electrical Engineering	924	Mining and Metallurgy	942
Industrial Economy	929	Railway Engineering	950
Marine and Naval Engineering	931	Street and Electric Railways	954

CIVIL ENGINEERING

BRIDGES.

Abutments.

The Design of High Abutments. William M. Torrance. Illustrated description of interesting work in connection with double-tracking the Cairo bridge, across the Ohio River; Illinois Central R. R. 3300 w. Eng News—Jan. 11, 1906. No. 74333.

Accident.

Displacement of the Semi-Arches of a Stone Bridge. Illustrated description of an accident during erection of the Maximilian bridge at Munich. 2000 w. Engr, Lond—Dec. 29, 1905. No. 74300 A.

Arches.

A Graphostatic Examination of Flat Parabolic Arches (Graphostatische Untersuchung des Flachen Parabelgewölbes) Dr. Josef Schreier. A comparison of the graphical and analytical methods of investigating the stresses in masonry arches,

We supply copies of these articles. See page 957.

taking the parabola as the curve of equilibrium. 3500 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 22, 1905. No. 74618 D.

Eye-Bars.

New Facts About Eye-Bars. Theodore Cooper. States some incorrect assumptions that are generally accepted, describes an investigation carried out in connection with the erection of the Quebec Bridge, giving tabulated results, with their practical consideration and application. 4000 w. Pro Am Soc of Civ Engrs—Jan., 1906. No. 74702 E.

New York.

Main Vertical and Inclined Posts, Island Span, Blackwell's Island Bridge. Illustrated description of interesting details in the construction of this bridge across the East River, at New York City. 1500 w. Eng Rec—Jan. 27, 1906. No. 74769.

The Lower Chords of the Island Span of the Blackwell's Island Bridge. Illustrated description of the riveted bottom chords of the island span of the bridge across the East river at Blackwell's Island, New York City. 1200 w. Eng Rec—Jan. 6, 1906. No. 74274.

Nile.

The Nile Bridge at Cairo. Illustrations, with description of the construction work. 1000 w. Engng—Jan. 12, 1906. No. 74522 A.

Plate Girders.

Standard Plate Girders on the Chicago, Milwaukee & St. Paul Ry. Illustrated detailed description of the girders for shallow floor through plate girder bridges. 1800 w. Eng Rec—Jan. 20, 1906. No. 74501.

Railway Bridges.

Some Notable American Railway Bridges. James G. Walton. Illustrates and describes recently erected examples of steel bridge building as practiced in the United States. 100 w. Cassier's Mag—Jan., 1906. No. 74461 B.

Rhine.

The New Bridge over the Rhine at Bâle (Die Neue Basler Rheinbrucke). E. Gutzwiller. A general description of the new masonry arched bridge, with numerous illustrations. Serial. Part I. 1500 w. 1 plate. Schweiz Bauzeitung—Jan. 6, 1906. No. 74666 B.

Strengthening.

The Strengthening and Maintenance of Early Iron Bridges. William Marriott. Describes the measures adopted for the strengthening of two bridges built in the sixties and seventies, in order to adapt them to modern requirements and to protect them from rust. Discussion. Illus. 14500 w. Inst of Civ Engrs. (No. 3554.) No. 74356 N.

Substructure.

Substructure of Potomac River Highway Bridge, Washington, D. C. An illustrated detailed description of the construction work. 2000 w. Eng. Rec—Jan. 27, 1906. No. 74770.

Zambesi.

The Bridge over the Zambesi River at the Victoria Falls in Rhodesia (Die Bogenbrücke über den Sambesi Fluss bei den Victoriafällen in Rhodesia). G. Barkhausen. A detailed illustrated description of the Zambesi bridge, including structural elements and erection. 4500 w. Zeitsch d Ver Deutscher Ing—Dec. 30, 1905. No 74604 D.

CONSTRUCTION.

Building Construction.

See Reinforced Concrete.

Building Design.

The Architecture of Continental Power Plants. Franz Koester. Illustrates and describes examples of European power plant architecture. 2000 w. Elec Wld—Jan., 1906. No. 74310.

Caisson Disease.

Compressed Air Illness; or, Caisson Disease. Thomas Oliver. Abstract of a lecture at the Roy. Inst. of Pub. Health, London. Describes a caisson, and the "compression" and "decompression" of workmen, the admission of pure air, and ventilation. The hygiene and symptoms are discussed, and the prevention and treatment of caisson disease. 4000 w. Min Jour—Jan. 6, 1906. No. 74411 A.

Columns.

The Theory of Continuous Columns. Ernest F. Jonson. Develops the exact theory of continuous columns in order to deduce from it a simple method of calculating the effect of eccentric loading, both at the floor level and at an intermediate point. 1600 w. Pro Am Soc of Civ Engrs—Jan., 1906. No. 74701 E.

Concrete.

Concrete Construction for the B. T. Babbitt Works. Illustrates and describes the construction of extensive works for the manufacture of soap, about nine miles from Jersey City. 1400 w. Eng Rec—Dec. 30, 1905. No. 74138.

Legal Requirements in Regard to Concrete Building Construction. Rudolph P. Miller. Abstract of a paper read at the meeting of the Nat. Assn. of Cement Users. Discusses the quality of the cement and associated material, legal requirements for workmanship, etc. 4000 w. Eng News—Jan. 25, 1906. No. 74567.

Retempered Mortar in Concrete Work. Ernest McCullough. Information concerning excellent results obtained by an old English mason, especially in patching and

repairing old concrete. 1000 w. Eng News—Jan. 11, 1906. No. 74331.

Dams.

Completion of the New Croton Dam. An illustrated article giving information in regard to the methods of construction, cost, and design of this important work. 2500 w. Eng Rec—Jan. 6, 1906. No. 74275.

Internal Stresses in Masonry Dams. S. D. Bleich. Walls containing water only are considered as illustrative of all others. A mathematical study of the distribution of shear along horizontal and vertical planes. 1200 w. Sch of Mines Qr—Nov., 1905. No. 74547 D.

Excavation.

A Machine for Excavating Narrrow Ditches (Maschine zum Ausheben Schmaler Graben). Eugen Eichel. Describing an American apparatus using a revolving wheel carrying excavating buckets for digging ditches for drain pipes. 1000 w. Zeitscher d Ver Deutscher Ing—Jan. 13, 1906. No. 74612 D.

Methods and Cost of French Excavation with a French Digging Machine. Halbert P. Gillette. Gives cost data relating to excavating trenches with a machine, showing that the work can be done at a cost that compares favorably with dredging and hydraulicing. 1800 w. Eng Rec—Dec. 30, 1905. No. 74136.

Frameworks.

The Graphical Determination of the Lines of Pressure in Framed Structures (Graphische Ermittlung der Einflusslinien für die Spannungen im Fachwerk). S. K. Drach. Discusssing especially the case of a three-hinged framed arch. 2500 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 29, 1905. No. 74620 D.

Fireproofing.

See Reinforced Concrete.

Fire Protection.

The Vienna Model Theatre for Fire Tests (Das Wiener Modelltheater für Brandversuche). H. Harder. An account of the tests made upon a model building to determine the best methods of protecting theatres against fire. 3000 w. Gesundheits Ingenieur—Dec. 20, 1905. No. 74669 B.

Foundations.

Foundations for Chicago Buildings. John M. Ewen. A short history of the foundations of Chicago buildings since the great fire, calling attention to the improvements made from time to time. Discussion. Ills. 4500 w. Jour W Soc of Engrs —Dec., 1905. No. 74553 D.

Rapid Construction.

Rapid Construction of an Industrial Plant. Illustrated description of the methods followed at the St. Croix Paper Company's Works, Sprague Falls, Me. 2000 w. Eng Rec—Jan. 6, 1906. No. 74273.

Reinforced Concrete.

A Reinforced Concrete Shoe Factory in Brooklyn. Illustrated description of an interesting example of factory design. 2500 w. Eng Rec—Jan. 20, 1906. No. 74503.

Fireproof Construction and Prevention of Casualties by Fire. H. F. J. Porter. In discussion of paper by E. N. Hunting before the A. S. M. E. Urges the development of a regular fire corps in factories and shops, fire drills, &c. 1700 w. Am Mach—Vol. 29, No. 1. No. 74209.

Notes on Reinforced Concrete. J. R. Worcester. Read before the Boston Soc. of Archts. Discusses the quality of the cement used, the advantage of reinforcement, the applications made of this material, the difficulties and disadvantages, &c. 4500 w. Am Archt—Jan. 6, 1906. No. 74230.

Reinforced Concrete Fence Posts. Philip L. Wormsley, Jr. Extract from Farmers' Bulletin, Dept. of Agriculture. Gives information concerning the construction recommended, and report of tests. Ills. 2500 w. Eng News—Jan. 18, 1906. No. 74458.

Reinforced Concrete. Harrison Albright. Points out some of the stumbling blocks which beginners are apt to meet in their first attempts in reinforced concrete construction, and the essentials to success. 1600 w. Cement—Jan., 1906. No. 74193 C.

Reinforced Concrete in Building Construction. Discussion by Messrs. Emile G. Perrot, Walter Loring Webb, C. A. Hexamer, James S. Merritt, and E. P. Cowell. Ills. 8000 w. Jour Fr Inst—Jan., 1906. No. 74549 D.

Reinforced Concrete Water Tower at Bordentown, N. J. Briefly outlines recent changes made in the water supply, and describes the tower. Ills. 2000 w. Eng Rec —Jan. 13, 1906. No. 74386.

The Reinforced Concrete Factories for the Bush Terminal. Illustrated detailed description of factories which are in process of construction in South Brooklyn. 2500 w. Eng Rec—Jan. 13, 1905. No. 74385.

U. S. Naval Academy Chapel, Annapolis, Md. Illustrations, with brief description of this interesting example of the use of concrete in building operations. 1000 w. Cement—Jan., 1906. No. 74191 C.

See Civil Engineering, Materials.

Retaining Walls.

Concrete Retaining Wall and Tunnel. Herbert I. Bennett. Illustrated description of a tunnel through the Santa Cruz Mountains, which has stood eleven years

without showing the least sign of cracks or other failure. 1000 w. Sci Am Sup—Jan. 13, 1906. No. 74391.

Heavy Concrete Retaining Walls, Illinois Central R. R. An illustrated description of the construction of a concrete retaining wall in connection with the improvements being carried out by the South Park Commissioners of Chicago. 2000 w. Eng Rec—Jan. 27, 1906. No. 74765.

Roads.

County Road Construction. A topical discussion. 4000 w. Pro Engrs' Soc of W Penn—Jan., 1906. No. 74541 D.

The Office of Public Roads. Excerpt from the report for 1905 of Hon. James Wilson, Secretary of Agriculture. Gives an idea of the work undertaken and the results attained up to the present time. 3800 w. Eng Rec—Jan. 27, 1906. No. 74771.

Roofs.

Temporary Structures in Wood (Halles Provisoires en Bois). A description of recent buildings in Switzerland, covered by timber roofs of large span. 1000 w. Génie Civil—Dec. 16, 1905. No. 74624 D.

The Charing Cross Disaster. Editorial on the verdict given at the coroner's inquest as to the cause of the disaster, showing that the roof collapsed owing to the breakage of a tie-bar which had a concealed flaw. Ills. 1500 w. Engng—Jan. 12, 1906. No. 74525 A.

The Lesson of the Charing Cross Accident. Editorial discussing whether iron and steel ought to be regarded as permanently trustworthy materials of construction. Gives drawings and a brief description of the main constructional features of the Charing Cross station, with added information. 4800 w. Builder—Dec. 23, 1905. No. 74123 A.

The Timbering of the Charing Cross Station Roof. Illustrations showing the work in progress at the station, with brief description. 600 w. Engng—Dec. 29, 1905. No. 74296.

Tunnels.

Construction of Indigo Tunnel, Western Maryland R. R. Describes the construction of this tunnel, driven through very dense rock which did not require timbering. The method of driving the lower heading first and then taking the remainder above in a single lift is explained. 1800 w. Eng Rec—Jan. 27, 1906. No. 74768.

Scranton Tunnel of the Lackawanna & Wyoming Valley. An illustrated description of this tunnel on the third-rail electric line between Scranton and Wilkesbarre, Pa. 800 w. R R Gaz—Vol. XL. No. 2. No. 74329.

MATERIALS OF CONSTRUCTION.

Brick.

Sand-Lime Brick. E. W. Lazell. Considers the materials, methods of manufacture, and the uses, reporting the results of tests. 2500 w. Pro Engrs' club of Phila.—Jan, 1906. No. 74532 D.

Cement.

Cement Production and Manufacture in the United States. Edwin S. Eckel. A detailed study of the cement industry in the United States; showing its rapid growth in recent years. 3000 w. Engineering Magazine—Feb. 1906. No. 74675 B.

Cement. Robert W. Lesley. A review of the cement industry for the year, the enormous growth of the production in the United States, the distribution, market, etc. 2500 w. Eng & Min Jour—Jan. 6, 1906. No. 74268.

Report of the Committee of the National Fire Protection Association on Cement for Building Construction. Remarks on the material, with report of tests made and the results. 3500 w. Cement—Jan. 1906. No. 74190 C.

The Development in the Uses of Cement Richard L. Humphrey. Presidential address before the Nat. Assoc. of Cement Users. Historical review. 2500 w. Eng. Rec—Jan. 27, 1906. No. 74766.

Concrete.

Concrete Aggregates. Sanford E. Thompson. Read before the Nat. Assn. of Cement Users. Enumerates the general principles which should be followed in the selection of sand and stone for mortar and concrete, and describes the method of testing aggregates and determining proportions. 3500 w. Eng Rec—Jan. 27, 1906. No. 74773.

The Action of Sea-Water upon Concrete. J. Watt Sandeman. Gives a record of results based on actual tests, and long experience in the construction of dock and pier works in concrete, concerning the standard proportions for concretes which enable them to permanently resist the action of sea-water. 1200 w. Engng—Jan. 5, 1906. No. 74414 A.

Concrete Blocks.

Principles of success in Concrete Block Manufacture. Louis H. Gibson. Discusses some of the reaons why this material is not more popular with architects and the public. Ills. 3000 w. Munic Engng—Jan, 1906. No. 74187 C.

The Manufacture of Concrete Blocks and Their Use in Building Construction. W. G. Hayne. Fifth prize paper. Discusses the location and design of the plant, its equipment, the materials used, methods, etc. 6500 w. Cement Age—Jan., 1906. No. 74315.

We supply copies of these articles. See page 957.

Corrosion.

Protection of Structural Work from Rust. Robert Job. Reports experiments showing that the greater the degree of fineness of the pigment, the greater durability of the service. 900 w. Am Mfr—Jan. 11, 1906. No. 74341.

The Action of Slightly Alkaline Waters on Iron. Cecil H. Cribb and F. W. F. Arnaud. Abstract of a paper read before the Soc. of Pub. Analysts. Shows that an action occurs, often equal to that which takes place in the absence of an alkali. 1200 w. Engng—Jan. 5, 1906. No. 74422 A.

The Corrosion of Fence Wire. Report of an investigation by the Department of Agriculture. 3000 w. Ir Age—Jan. 11, 1906. No. 74305.

Lime.

The Rapid Volumetric Determination of Lime. Richard K. Meade. Outlines a rapid method applicable to materials in which the lime is present as either oxide, carbonate or silicate. 1000 w. Am Mfr—Jan. 11, 1906. No. 74342.

Piles.

New Concrete Covering for Timber Piles in Teredo-Infested Waters. Briefly refers to the forms of protection used, and the objections to them, and gives an illustrated description of a lock-joint concrete pipe armoring. 600 w. Eng News—Jan. 4, 1906. No. 74177.

Recent Improvements in Piles. An illustrated article showing what is being done by means of concrete, and steel and concrete, to supersede the old wooden piles. 2200 w. Engr, Lond—Jan. 19, 1906. Serial. 1st part. No. 74753 A.

Plaster.

Lime vs. Gypsum Plaster. R. S. Edwards. First prize paper. Aims to show the advantages in the use of large quantities of lime, and the ill effect caused by too large percentages of gypsum plaster. 3500 w. Cement—Jan, 1906. No. 74192 C.

Reinforced Concrete.

A new method of Calculating the Proportions of Reinforced-Concrete Structures (Nouvelle Méthode de Calcul des Ouvrages en Béton Armé). Col. G. Espitallier. Describing methods and results of tests showing measurements of the actual elasticity of the metal and concrete, with computations based thereon. 2500 w. Génie Civil—Jan. 6, 1906. No. 74634 D.

Armored Concrete. Henry J. Jones, in *Technics*. Discusses the economy of this material and its value, the systems and methods, giving information concerning its use. Ills. 2200 w. Sci Am Sup—Jan. 13, 1906. Serial. 1st part. No. 74389.

Bending Tests on Reinforced Concrete Beams (Biegungsversuche mit Armierten Betonbalken) E. Mörsch. Giving diagrams of deflections and extensions, showing the relative action of the concrete and metal. 2000 w. Schweiz Bauzeitung—Dec. 16, 1905. No. 74665 B.

Forms of Concrete Reinforcement. Illustrated discussion of the forms of metal most widely used for reinforcement. 4300 w. Ir Age—Jan. 11, 1906. No. 74304.

Shear and Adhesion in Reinforced Concrete. Editorial discussion of this material, its uses and limitations; suggesting lines along which experimental investigation is still needed, and giving conclusions arrived at from recent tests by J. J. Harding, and remarks on the lessons taught by them. 3000 w. Engng—Jan. 5, 1906. No. 74420 A.

Some Further Tests of Reinforced-Concrete Beams, C. M. & St. P. Ry. J. J. Harding Describes tests made by the Bridge & Building Dept. of the road named with a study of the results and statement of conclusions. General discussion. Ills. 10500 w. Jour W Soc of Engrs—Dec, 1905. No. 74554 D.

See Civil Engineering, Construction.

Testing.

Some Experiments on the strength of Brickwork Piers and Pillars of Concrete. William Charles Popplewell. Describes experiments carried out in the vertical 750-ton compression testing-machine, at the Municipal School of Technology, Manchester. 4000 w. Eng News—Jan. 4, 1906. No. 74171.

Timber Treatment.

The Inspection of Treatment for the Protection of Timber by the Injection of Creosote Oil. Discussion of paper by H. R. Stanford. 5500 w. Pro Am Soc of Civ Engrs—Jan, 1906. No. 74704 E.

Wire Rope.

Notes on the Theory of Wire Rope (Beiträge zur Theorie der Drahtseile). Dr. Hans Benndorf. A continuation of the author's studies in July, 1904, comparing the computed elasticity of wire ropes with the results obtained by experiment. 7000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 15, 1905. No. 74617 D.

MEASUREMENT.

Field Instruments.

Repairing Engineers' Field Instruments. E. M. Douglas. Suggestions for making temporary repairs and for the care of instruments. 1600 w. Eng News—Jan. 25, 1906. No. 74564.

MUNICIPAL.

Fire Hazards.

Fire Hazards and How to Avoid Them. Washington Devereux. A statement of existing conditions from the fire hazard

standpoint, with suggestions for care and construction of buildings. 5500 w. Cassier's Mag—Jan., 1906. No. 74462 B.

Fire Service.

Electricity in the Service of the Fire Brigade. Frank Broadbent. Reviews some applications that have already been noticed, and remarks that the chief difficulty is in obtaining a supply of electricity near the scene of the fire. 1800 w. Elec Rev, Lond—Jan. 19, 1906. No. 74737 A.

Garbage.

Garbage Disposal. Joseph G. Branch. Advocates incineration in preference to reduction for city refuse. 900 w. Munic Jour & Engr—Jan., 1906. No. 74133 C.

Municipal Improvements.

A New Year's Survey of Municipal Conditions. Editorial on the great increase in facilities that were formerly confined to large cities, and the number of industries owned municipally. Discusses also various classes of work done by municipalities, and the recent progress. Considers the outlook most promising. 4000 w. Eng News—Jan. 4, 1906. No. 74175.

Pavements.

Street Pavements in Chicago. John W. Alvord. Describes past and present conditions of the streets, and considers the progress and future outlook. 2000 w. Jour W Soc of Engrs—Dec., 1905. No. 74552 D.

Sewage.

Sewage Purification, with Notes on English and German Works. Charles F. Mebus. Principally a discussion of English works, with brief notes on German works. General discussion. 6000 w. Pro Engrs' Club of Phila—Jan., 1906. No. 74533 D.

The Scientific Disposal of City Sewage: Historical Development and Present Status of the Problem. C. E. A. Winslow. Discusses briefly the various methods tried in both Europe and America, and gives the opinion that only experimentation in each case will determine what method is most desirable. 6500 w. Tech Qr—Dec., 1905. No. 74584 E.

The Sewage Purification Works at Columbus, Ohio. Julian Griggs. Illustrates and describes the purification works to be built as a result of the investigations during one year to ascertain the most efficient and economical method of purifying the dry weather sewage flow. The method comprises septic tanks, sprinkling filters and settling basins. 3800 w. Eng Rec—Dec. 30, 1905. No. 74135.

The Tankage of Sewage. F. Wallis Stoddart. Read before the Roy. Inst. of Pub. Health. Discusses the causes of offensive odors. Tank capacity, secondary deposits, rate of flow through tank, and sludge disposal are considered. 5000 w. Munic Engng—Jan., 1906. No. 74188 C.

West Riding Rivers. Begins a detailed history of the Bradford sewage disposal question, showing the difficulties of the West Riding Rivers Board in its struggle against river pollution. 4000 w. Engng—Jan. 10, 1906. Serial. 1st part. No. 74745 A.

What Methods Are Most Suitable for Disposal of Sewage on the Atlantic Coast? George W. Fuller. Address at meeting of the New Jersey Sanitary Assn. Considers briefly recent additions to the evidence upon the subject of sewage disposal, and the practical conclusions now available. 3000 w. Eng News—Jan. 25, 1906. No. 74566.

Sewers.

Breakage in Sewer Conduits: Its Cause, Effect and Prevention. Alexander Potter. Gives information based on a study of the Joint Trunk Sewer in New Jersey. Also discusssion. 9500 w. Jour Assn of Engng Socs—Dec., 1905. No. 74379 C.

Outfall Works and Inverted Siphons for the New Sewerage System at Hamburg (Die Versenkung der Dükerrohre durch den Niederhafen und die Mündungsanlage der Neuen Stammsiele in Hamburg). Curt Merckel. Describing especially the construction and sinking of the inverted siphons for the new drainage system of Hamburg. Serial. Part I. 3000 w. Zeitschr d Ver Deutscher Ing—Jan. 13, 1906. No. 74609 D.

The Sewerage of Springfield, Ohio. W. H. Sieverling. The proposed works are described and illustrated. 1700 w. Munic Jour & Engr—Jan., 1906. No. 74134 C.

Street Traffic.

Expert Report on San Francisco's Street Traffic Problems. An illustrated article describing the scheme outlined by William Barclay Parsons for the development and improvement of the city's transportation and street traffic arrrangements. Also editorial. 10000 w. St Ry Jour—Jan. 6, 1906. No. 74227 C.

WATER SUPPLY.

Bore Holes.

Borehole at Malvern. An interesting account of difficulties encountered and overcome in the work of sinking boreholes to increase the water supply of this English watering place. Describes the tools used, one of which became set at a depth of 740 ft. Ills. 1500 w. Engr, Lond—Jan. 19, 1906. No. 74756 A.

Coolgardie.

Coolgardie Water Supply. Charles Stuart Russell Palmer. Gives briefly the history and topography of the district, with illustrated description of the design

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and construction of the works undertaken for the water supply of this district in Western Australia. Discussion. 65000 w. Inst of Civ Engrs (No. 3516). No. 74369 N.

Dams.

See Civil Engineering, Construction.

Filters.

Cleaning the Old Sand Water Filters at Hudson. An account of the method of cleaning, which had to be done very economically and with a limited supply of water. 2000 w. Eng Rec—Jan. 20, 1906. No. 74500.

High Pressure.

High Pressure Water Supplies for Fire Purposes. Points from a report of a committee of the National Fire Protective Assn. of special interest to water-works superintendents and engineers. 3000 w. Munic Engng—Jan., 1906. No. 74189 C.

Irrigation.

An Example of Irrigation in the Arid Regions of the United States. George Frederick Vollmer. A description of a typical irrigation scheme which has been carrried out by a private company called the Wyoming Development Company. Ills. 3000 w. Inst of Civ Engrs (No. 3553). No. 74353 N.

Lead Poisoning.

Plumbism Due to Electrolysis. Baldwin Latham. Read before the Brit. Assn. of W. Wks. Engs. Gives an account of a case of lead poisoning carefully investigated, and pronounced as entirely due to electrolysis. 2500 w. Elec Engr, Lond—Dec. 29, 1905. No. 74286 A.

New York City.

Water Hazards of New York City. Presents facts tending to show the pressing need of additional supply for the city, and information concerning the additional supply proposed. Editorial. 3500 w. Eng Rec—Jan. 13, 1906. No. 74387.

Pumping Station.

The District Pumping Station at Washington. W. A. McFarland. Illustrated description of the building and the present pumping equipment. 1800 w. Eng Rec—Jan. 20, 1906. No. 74499.

Reservoirs.

Note on the Underpinning of the Piers in the Reservoirs of the Galatz Waterworks, Roumania. Willliam Morris Langford. Illustrates and describes the manner of supporting the piers and their loads during repairs. 5000 w. Inst of Civ Engrs (No. 3551). No. 74352 N.

South Africa.

Port Elizabeth New Water Scheme. An illustrated article giving particulars of an important water scheme in South Africa, which is estimated to cost £360,000. It includes a dam and a new road on the Sand River, a dam tram line and new road in the Bulk River Valley, the pipe line, a tunnel, and a service reservoir. 2000 w. Engr, Lond—Jan. 19, 1906. No. 74755 A.

Water Tower.

See Civil Engineering, Construction.

WATERWAYS AND HARBORS.

Canals.

Canals Ancient and Modern. This first article of the series reviews the ancient history of the canals of various countries. 2000 w. Engr, Lond—Jan. 12. 1906. Serial. 1st part. No. 74528 A.

Cranes.

100-Ton Electric Wharf crane, Dublin Harbor. Illustration, with short description. 500 w. Engng—Jan. 19, 1906. No. 74747 A.

Dredges.

Russian Dredgers. A. Bormann. Read before the Milan Congress. Illustrated descriptions of dredges built entirely in Russia, by Russian firms. 4000 w. Naut Gaz—Jan. 11, 1906. No. 74365.

Harbor Works.

The Genoa Harbor Works. Reviews briefly the past history of the harbor works, and outlines the present scheme of enlargement. Plan. 2000 w. Engng—Jan. 19, 1906. No. 74744 A.

The Protection of Small Harbors on Lake Michigan. Notes from a report of a board appointed to inquire into the effect of wave action as injuriously affecting the harbors, and to suggest a plan of resisting this action. 4000 w. Eng Rec—Jan. 20, 1906. No. 74502.

Locks.

Canal Locks and Lifts (Ueber Schleusentreppen und Schiffshebewerke). Fr. Jebens. A comparison of locks in series with inclined planes and lifts for overcoming differences of level in canals. 1800 w. Glasers Annalen—Jan. 15, 1906. No. 74636 D.

Panama.

Proposed Excavation of the Panama Canal by Floating Dredges. An illustrated article giving an outline of the plans proposed by Mr. Bunau-Varilla for the rapid construction of a high-level canal, and its final enlargement to a sea-level canal. 1300 w. Sci Am—Jan. 20, 1906. No. 74440.

Report of the Chief Engineer of the Isthmian Canal Commission. Portions of the report of Mr. John R. Stevens, which are of special interest to engineers. 5800 w. Eng News—Jan. 4, 1906. No. 74172.

Work on the Panama Canal. Brief outline of this project and the work that has been done, with many illustrations. 1200

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w. Ry & Loc Engng—Jan., 1906. No. 74-197 C.

Pier.

Viaduct and Pier in Reinforced Concrete at the Cala Mines, Spain (Viaducs et Appointement en BtonN4 - vu$5N-| m ciété des Mines de Cala, Espagne). Juan Manuel de Zafra. Illustrating a pier and approaches constructed on the Hennebique system of reinforced concrete, for handling iron ore at a railway terminus on the Guadalquivir, below Seville. 2000 w. 1 plate. Génie Civil—Dec. 23, 1905. No. 74627 D.

Ports.

The Port of London. Editorial discussion of the present condition of this port, and its needs. 3000 w. Engng—Jan. 19, 1906. No. 74749 A.

Ship Canal.

The East Bay Neck Ship-Canal, Tasmania. Charles Napier Bell. A brief description of a ship-canal across a peninsula on the east coast of Tasmania, for the use of coasting steamers and fishing craft. 300 w. Inst of Civ Engrs. (No. 3563.) No. 74351 N.

MISCELLANY.

Review.

Civil Engineering in 1905. An editorial review of the year briefly considering the progress in the different countries. 5000 w. Engr, Lond—Jan. 5, 1906. No. 74-427 A.

ELECTRICAL ENGINEERING

COMMUNICATION.

Space Telegraphy.

Notes on a Wireless Telegraph System. C. C. F. Monckton. On the Trinidad-Tobago wireless system describing the working of the insulated Lodge-Muirhead sender. Ills. 2500 w. Elect'n, Lond—Jan. 12, 1906. No. 74518 A.

The Limiting Factors of Syntonic Wireless Telegraphy. J. Hettinger. Aims to show a method which permits the discussion of the practical value of syntony when the resonance curves are experimentally determined, and to prove that the resonance method, as utilized now, may be a partial solution for avoiding interference, but never can be a general one. 2000 w. Elec Engr, Lond—Dec. 22, 1905. No. 74139 A.

The Orling-Armstrong system of Wireless Telegraphy and Telephony. A. Frederick Collins. Illustrated detailed description of this system. 1500 w. Elec Wld & Engr—Dec. 30, 1905. No. 74166.

Telegraphy.

The Jones Phantoplex Telegraph System. Describes a system employing alternating currents of equal frequencies to be superimposed upon ordinary telegraph lines already operated by the present Morse systems, for increasing the facilities of the wires for the transmision of messages. Ills. 1000 w. Elec Wld & Engr—Dec. 30, 1905. No. 74167.

The London-Glasgow Underground Telegraph System. Illustrates and describes the construction of the pipe line in the present number. 1100 w. Elec. Rev, Lond—Jan. 12, 1906. Serial. 1st part. No. 74512 A.

DISTRIBUTION.

Accumulators.

See Electrical Engineering, Electrochemistry

Conductors.

The Choice of an Insulated Cable. Wallace S. Clark. Discusses points of value in the selection of the most economical types. 4400 w. Cent Sta—Jan, 1906. No. 74280.

New Jersey.

Power Generation and Distribution on the System of the Public Service Corporation of New Jersey. The present number gives an illustrated description of the Marion (Hackensack River) station. 2000 w. St Ry Jour—Jan. 6, 1906. Serial. 1st part. No. 74226 C.

The Electrical Distribution System of the Public Service Corporation of New Jersey. G. U. G. Holman. The present number is principally a review of the history of this organization, and an account of the distribution problem. 2500 w. Elec Wld—Jan. 13, 1906. Serial. 1st part. No. 74436.

Underground Mains.

The Maintenance of Underground Mains. George L. Black. Abstract of a paper read before the Glasgow Sec. of the Inst. of Elec Engrs. A practical paper containing many useful hints. 3500 w. Elect'n, Lond—Jan. 12, 1906. No. 74517 A.

Wiring.

Exposed Circuit Wiring. Louis J. Auerbacher. An illustrated article giving directions for the proper execution of the work, and information in regard to materials. 1600 w. Elec. Wld—Jan, 1906 No. 74312.

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ELECTRO-CHEMISTRY.

Accumulators.

Secondary Cells: Their Deterioration and the Causes. G. D. Aspinall Parr. Abstract of a paper read before the Leeds Loc. Sec. of the Inst. of Elec. Engrs. Considers impurities present in cells in small quantities are the chief cause of unsatisfactory working and deterioration, and reports experiments designed to support the statement. 2000 w. Elect'n, Lond—Dec. 29, 1905. No. 74292 A.

Storage Batteries and Their Application to Public Institutions. Frank Crawter. Abstract of a paper read before the Engrs.-in-Charge. Discusses methods of charging, and the changes that take place during the phenomena of charge and discharge, and various practices and their effects. Elect'n, Lond—Jan. 12, 1906. No. 74519 A.

Electrolysis.

Electrolysis by Alternating currents. Reviews some researches in this field, commenting on the results. 1500 w. Am Gas Lgt Jour—Jan. 22, 1906. No. 74481.

Galvanizing.

Electrolytical Galvanizing. Henry I. White. Report of mechanical and chemical tests in proof that steel and iron articles coated by the Electrolytical process are superior to those galvanized by the hot process in their resistance to both mechanical and atmospheric action. 1800 w. Ir Age—Jan. 18, 1906. No. 74433.

Hypochlorites.

The Production of a Disinfectant (Hypochlorite of Sodium) by Electrolysis. C. V. Biggs. Discusses the possibility of rendering the process a commercially successful one. 800 w. Elec Engr, Lond—Dec. 22, 1905. No. 74141 A.

Iron.

The Electrometallurgy of Iron and the Iron Alloys (Electrometallurgie des Eisens und der Eisenlegierungen). J. Hess. A review of the practical methods of smelting iron and refining steel by electrical processes. Serial. Part I. Zeitschr f Elektrochemie—Jan 12, 1906. No. 74663 G.

Nitrogen.

The Fixation of Atmospheric Nitrogen. Editorial discussing the importance of nitrogen in the household of nature; its chief sources, and what has been accomplished in utilizing the stores of the atmosphere. 3800 w. Engng—Jan. 19, 1906. No. 74750 A.

Ozone.

Recent Devices for the Production of Ozone (Neue Apparate zur Erzeugung von Ozon). Dr. Kausch. A general review of recent patents, with especial reference to water purification. Serial. Part I. 800 w. Elektrochemische Zeitschr—Dec., 1905. No. 74664 G.

Refining.

Electro-Chemical Refining of Copper. Birger Carlson. Translation of an important paper by a Swedish metallurgist, giving an impartial comparison of the multiple system and the series system in the electrolytic refining of copper, as carried on in the United States. 3500 w. Min Jour—Jan. 20, 1906. No. 74742 A.

Electro-Technical Industries. George E. Walsh. Calls attention to the effect of electrometallurgy on the manufacture and refining of articles of commerce, copper refining, artificial graphite, and the use of the electric furnace in various industries, etc. 1800 w. Sci Am—Jan. 20, 1906. No. 74438.

Review.

Electrochemistry and Electrometallurgy in 1905. Charles F. Burgess. Reviews the standing of the industries, the new products, the value of the electric furnace, etc. 2500 w. Elec Rev, N. Y.—Jan. 13, 1906. No. 74431.

Smelting.

Preliminary Report on the Smelting of Magnetic Iron Ore by Electricity. Preliminary report submitted by Dr. David, T. Day on the subject of smelting by electricity the magnetic iron ores obtained from various points on the Pacific beach. 1200 w. Min Rept—Dec. 28, 1905. No. 74111.

ELECTRO-PHYSICS.

Conductivity.

On the Electric Conductivity of a Vacuum. J. A. Fleming in *Technics*. An account of experimental investigations showing that certain conditions change the results, and giving facts explaining the phenomena, and a general study of the subject. 4000 w. Sci Am Sup—Jan. 20, 1906. No. 74444.

Discharges.

High-Potential Discharges. A. Frederick Collins. A review of disruptive discharges in their application to wireless telegraphy, and connective discharges in their relation to the human body. Ills. 1500 w. Sci. Am—Jan. 27, 1906. No. 74571.

The Electric Spark. Dr. G. A. Hemsalech in the *La Science au XXme Siècle*. An illustrated article considering only sparks produced by the discharge of condensers through air at ordinary atmospheric pressure. 5000 w. Sci Am Sup—Jan. 27, 1906. No. 74575.

Oscillations.

Phase-Shifted High-Frequency Oscillations. Prof. Ferdinand Braun. Gives abstract translation of an article on phase-displacement measuring, published in

Physikalische Zeitschrift. Considers phase displacement by ohmic resistance, and by resonance. Ills. 4000 w. Elect'n, Lond—Jan. 19, 1906. No. 74740 A.

Radioactivity.

The Heating Effects Produced by Röntgen Rays in Different Metals, and Their Relation to the Question of Changes in the Atom. H. A. Bumstead. An account of experimental investigations, describing the apparatus used and giving results and conclusions. 7500 w. Am Jour of Sci—Jan, 1906. No. 74178 D.

The Present Position of Radioactivity. Frederick Soddy. Abstract of presidential address to the Röntgen Society. 5500 w. Elect'n, Lond—Jan. 5, 1906. No. 74408 A. A.

Resistance.

Brush-Contact Resistance. K. C. Nandi. An account of some experiments made at the Glasgow University. 600 w. Elec Engr, Lond—Jan. 5, 1906. No. 74403 A.

GENERATING STATIONS.

Accumulators.

See Electrical Engineering, Electrochemistry.

Alternators.

A Note on the Calculation of the Armature Reaction of Alternators. Waldo V. Lyon. A discussion showing the assumptions that must be made to calculate the armature reaction as it is ordinarily done. Considers first a single-phase alternator, and then a three-phase machine. 3000 w. Tech Qr—Dec., 1905. No. 74588 E.

A Self-Exciting Alternator. E. F. Alexanderson. Illustrated description of an electric generator with rectifying commutator and automatic voltage regulation by three-phase field rheostat. 3500 w. Pro Am Inst of Elec Engrs—Jan., 1906. No. 74762 D.

The Wiring and Connection of Alternators. G. A. Burnham. An illustrated explanation of the three classes of alternators; the revolving armature, the revolving field, and the inductor type. 1600 w. Engr, U S A—Jan. 15, 1906. No. 74478 C.

Armature Windings.

Winding of Direct-Current Armatures. A. C. Jordan. An illustrated detailed description of the 101 B armature, with especial reference to the points of difference between this and the 38 B type. Type S armatures are also described, with general considerations of armature windings. 2000 w. Elec Jour—Jan, 1906. No. 74538.

Booster.

A Reversible Booster and Its Running. C. Turnbull. Read before the Newcastle Local Sec. of the Inst. of Elec. Engrs. An illustrated description of the Lancashire booster, its working and all matters relating to its application. 6000 w. Elec Engr, Lond—Jan. 19, 1906. No. 74736 A.

Brushes.

Brush Holders. Bernhard Zingelmann. Remarks on recent devices and improvements, and the requirements of a good brush-holder. 1800 w. Elec Rev, Lond—Jan. 12, 1906. No. 74513 A.

Chicago.

Power Plant of the Chicago Drainage Canal. An illustrated article dealing principally with the power-house and its equipment. 3900 w. Eng News—Jan. 18, 1906. No. 74457.

Combined Plant.

An Ice-Making Electric Light Station in Florida. James F. Hobart. Describes the plant of the Plant City Electric and Refrigerating Company and its operation. Ills. 1400 w. Elec Wld—Jan. 13, 1906. No. 74437.

Commercial Problems.

Commercial and Engineering Tendencies Affecting Central Stations. J. H. Hallberg. A review of recent developments in power stations, distribution, lighting and other service. 3000 w. Elec Rev, N. Y.—Jan. 13, 1906. No. 74430.

Costs.

Cost of Generating Electric Power. F. A. Giffin. Gives formulæ and figures intended to be applicable to a modern, power-station containing four 1000-kw. units, and assumptions are made regarding the manner in which the efficiency of each piece of apparatus varies with the load. 2000 w. St. Ry Jour—Dec. 30, 1905. No. 74122 C.

Dynamos.

Auxiliary Reversing Poles for Large Continuous-Current Dynamos. H. M. Hobart. On the use of auxiliary reversing poles for direct-current, turbine driven generators. Shows how this pole can be applied to a 750-kw., 250-volt generator driven at 1500 revolutions, showing the considerations entering into the design. Ills. 3500 w. Elec Rev, N. Y.—Jan. 20, 1906. No. 74468.

Efficiency.

Power Plant Economics. Henry G. Stott. An analysis of the losses in the conversion of coal into electric current, and discussion of means for diminishing them, with account of the latest practice in prime movers and other electric station features. Diagrams and tables. 5000 w. Pro Am Inst of Elec Engrs—Jan, 1906. No. 74761 D.

Hydro-Electric.

Additional Power Development at Sewalls Falls, N. H. Edw. B. Richardson.

We supply copies of these articles. See page 957.

Illustrated detailed description of a new power station on the Merrimac River, in which vertical direct-connected units were installed. 5000 w. Eng Rec—Jan. 6, 1906. No. 74277.

A High Head Water Power Electric Plant on the Animas River, Colo. George M. Peek. Illustrates and describes a plant employing a static head of nearly 1000 ft. and generating electric current at 50,000 volts pressure for transmission to the important mining camps of Durango and Silverton, 25 miles distant. 1500 w. Eng News, Jan. 4, 1906. No. 74168.

Hydro-Electric Lighting and Power Plant at Harrisonburg, Virginia. F. F. Coleman. Illustrates and describes a plant on the Shenandoah River which is an example of the possibilities in the development of numerous single waterfalls. 200 w. Elec Wld & Engr—Dec. 30, 1905. No. 74165.

Jhelum River Hydroelectric Power Installation in British India. Gives a description of the water-wheels and generator connections. 1600 w. Elec Rev, N. Y.—Jan. 6, 1906. No. 74234.

The Hydraulic Accumulator Station at Ruppoldingen, Switzerland, (Die Akkumulierungsanlage in Ruppoldingen, in der Schweiz). S. Herzog. Power is stored hydraulically to aid in overcoming the peak of the load on the dynamos. Two articles, 4000 w. Zeitschr f Elektrotechnik —Dec. 17, 24, 1905. No. 74657 each D.

The Hydro-Electric Power Station of the City of Preran, Moravia (Hydroelektrische Kraftzentrale der Stadt Preran). A. Martinek. Plans of the buildings and details of the turbines. 1500 w. Elektrotech u Maschinenbau—Jan. 1, 1906. No. 74659 D.

The Jhelum River Power Plant. Illustrated account of this installation in British India, describing the country and also the plant. 4500 w. Jour of Elec—Jan., 1906. No 74307 C

The Mazarin Hydro-Electric Station (Installation Hydro-Electrique de l'Usine Mazarin). Ch. Dantin. An illustrated description of the hydraulic plant at Mézieres in the North of France, utilizing the power of the Meuse and delivering it to the Clément automobile works. 2000 w. 1 plate. Génie Civil—Dec. 16, 1905. No. 74622 D.

The Montbovon Hydro-Electric Station (L'Usine de Montbovon). D. Gauchat. Describing the plant utilizing the power of the Sarine above the lake of Geneva, Switzerland. 1800 w. Bull Tech de la Suisse Rom—Jan. 10, 1906. No. 74668 D.

The Plant of the Vancouver Power Company (Ltd.). Wynn Meredith. Illustrated detailed description of this interesting plant on the Pacific Coast, the power of a glacial lake being utilized. 5800 w. Jour of Elec—Jan., 1906. Serial. 1st part. No. 74306 C.

Management.

Central Station Economics in Massachusetts. A study of two typical medium-sized companies. The Salem Electric Lighting Co. and the Haverhill Electric Co. are considered. 2800 w. Elec Wld—Jan., 1906. No. 74314.

The Management of Small Central Stations. Henry Joseph. Discusses day loads and the necessity of keeping capital costs as low as possible on small systems. Meters and the prepayment system are also considered. 2800 w. Elec Rev, Lond —Dec. 29, 1905. No. 74290 A.

Marion.

The Marion (Hackensack River) Station of the Public Service Corporation of New Jersey. Illustrated detailed description of this station and its equipment. 2000 w. Elec Wld—Jan., 1906. No. 74309.

Relay.

The Overload and Reverse Current Relay. An illustrated description of an automatic device in which an increase in current starts a motor which operates a circuit breaker. 3000 w. Elec Rev, Lond—Dec. 29, 1905. Serial, 1st part. No. 74291 A.

Rural Service.

District Supply in Rural Communities. Gives accounts of plants successfully operating a district supply service of electric light and power, with general remarks. 3500 w. Elec Wld—Jan., 1906. No. 74313.

Supervision.

Official Supervision of Electric Plants (Die Beabsichtige Staatliche Ueberwachung Elektrischer Anlangen). H. Passavant. A discusssion of the proposed government supervision of electric stations, showing that many other departments of industry are far more dangerous. 6000 w. Elektrotech Zeitschr—Dec. 28, 1905. No. 74656 B.

Switch Gear.

Notes on Heavy Electric Switch Gear. J. Whitcher. Abstract of a paper read before the Rugby Engng. Society. Considers types of switches and circuit breakers. Short discussion. 2500 w. Elect'n, Lond—Jan. 5, 1906. No. 74407 A.

The Ferranti-Field Three-Phase Switch. Illustrated description of one of the most recent designs of a large three-phase oil switch and its working. 1500 w. Engng —Jan. 5. 1906. No. 74418 A.

Switzerland.

Swiss Electrolytic Plants. C. L. Durand. Brief illustrated description of features of the plants at La Praz and at Cheddes. 1500 w. Elec Rev, N Y—Jan. 6, 1906. No. 74233.

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Turbo-Alternators.

Design of Turbo-Alternators. H. S. Meyer. Gives complete technical data of the 2,000 kw. turbo-alternators recently built for Yorkshire and Lancashire Power Co. Ills. 3800 w. Elect'n, Lond—Jan. 12, 1906. No. 74516 A.

LIGHTING.

Factories.

Factory Lighting. E. Leavenworth Elliott. Suggestions for the successful illumination of various factories by electricity. 2500 w. Cent Sta—Jan., 1906. No. 74279.

Interiors.

The Lighting of Living Rooms and Parlors. J. R. Cravath and V. R. Lansingh. An illustrated article considering examples of good and bad lighting, and discussing the essentials of satisfactory arrangements. 3500 w. Elec Wld—Jan., 1906. No. 74311.

MEASUREMENT.

High Frequency.

The Measurement of High Frequency Currents and Electric Waves. Prof. J. A. Fleming. Cantor lectures. Explains the methods of measurement used in the writer's investigations, illustrating instruments. 5000 w. Jour Soc of Arts—Dec. 29, 1905. Serial. 1st part. No. 74282 A.

Induction.

A Method for the Measurement of Self-Induction. Ernest Wilson and W. H. Wilson. Describes a method found convenient in practice. 900 w. Elect'n, Lond Jan. 5, 1906. No. 74405 A.

Meters.

Two New Electrolytic Meters. S. H. Holden. Illustrates and describes two new electrolytic meters, both of which belong to the gas voltometer type, one belonging to the shunted and the other the unshunted class. Short discussion. 3500 w. Elect'n, Lond—Dec. 22, 1905. No. 74144 A.

Standards.

The National Bureau of Standards. S. W. Stratton and E. B. Rosa. Illustrated detailed description of the buildings and equipment and the methods of carrying out the work. 13000 w. Am Inst of Elec Engrs—Dec., 1905. No. 74181 D.

Testing.

A Testing Laboratory in Practical Operation. Clayton H. Sharp. An account of the results attained in the establishment and maintenance of a laboratory for commercial electrical testing. 2800 w. Am Inst of Elec Engrs—Dec., 1905. No. 74182 D.

The Electrical Equipment of a D. C. Test Room for an Electricity Supply Undertaking. A. C. Johnson. Illustrates and describes the test room equipment at Burnley, England. 1700 w. Elec Rev, Lond—Jan. 19, 1906. No. 74739 A.

MOTORS.

Alternating.

Electric Traction by Alternating-Current Motors. Dr. Louis Bell. Comparing the alternating and the continuous-current motors, with especial reference to electric traction on main line railroads. 3000 w. Eng Mag—Feb., 1906. No. 74671 B.

Continuous Current.

The Use of Shunt, Compound, and Series-Wound Motors. F. W. Holbrook. Aims to give a clear understanding of the fitness and unfitness of the various types of windings with respect to the duty to be performed. 3000 w. Engr. U. S. A.—Jan. 15, 1906. No. 74479 C.

Control.

Automatic Control for Large Direct-Current Motors. H. D. James. An illustrated description of a controller capable of handling a motor of 900 h. p. and its behavior under test. 1200 w. Elec Jour—Jan., 1906. No. 74537.

Methods of "Changing Speed" in Electric Motor Driving. E. Kilburn Scott. An illustrated discussion of the methods in use, both mechanical and electrical. 2000 w. Ir & Coal Trds Rev—Jan. 12, 1906. No. 74530 A.

Induction Motors.

Locating Faults in Induction Motors. E. B. Raymond. Calls attention to certain characteristics of the induction motor, and discusses troubles that sometimes prove annoying and puzzling. 1800 w. Engr. U S A—Jan. 15, 1906. No. 74477 C.

Single Phase.

Alternating-Current Commutator Motors. (Wechselstrom-Kommutator motoren). F. Niethammer. A mathematical examination of the various types of single-phase commutator motors, with diagrams showing sparking pressures and operative relations. Two articles. 3000 w. Elektrotech u Maschinenbau—Jan. 1, 7, 1906. No. 74658 each D.

A Study of a Single-Phase Series Motor. George I. Rhodes. Illustrated report of test made. 2000 w. Tech Qr—Dec., 1905. No. 74587 E.

Notes on the Application of the Single-Phase Motor for Traction Service (Beitrag zum Entwurf von Einphasenserienmotoren für Bahnzwecke). Emil Dick. A comparison of the advantages of the single-phase alternating motor with the continuous current motor for railways. Serial. Part I. 2500 w. Elektrotech u Maschinenbau—Jan. 7, 1906. No. 74662 D.

See also Street and Electric Railways.

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TRANSMISSION.

Direct Current.

Long Distance Power Transmisssion by Direct Current. Frank J. Sprague. Discussses the economic side of direct-current transmission, referring to the Victoria Falls project. Also editorial. 3800 w. Elec Wld & Engr—Dec. 30, 1905. No. 74164.

High-Tension.

A Pertinacious Current; or the Storage of High-Tension Electricity by Means of Valves. Sir Oliver Lodge, before the Royal Inst. of Gt. Britain, explains this method of securing and maintaining a continuous high-tension current, and some uses to which it may be applied. 3500 w. Sci Am Sup—Jan. 13, 1906. No. 74390.

Electric Mains for Power Transmission Work. Prof. John T. Morris. Read before the Junior Inst. of Engrs. A brief account of some of the main considerations which affect high-tension transmission. Deals with the apparatus used for transmission of currents at voltages from 5000 to the maximum voltage used. 4500 w. Elec Engr, Lond—Dec. 29, 1905. Serial. 1st part. No. 74287 A.

Losses.

Economical Loss in Electric Transmission. G. R. Henderson. Discusses the cost of excess plant necesssary because of line losses. 1200 w. Am Engr & R R Jour—Jan., 1906. No. 74101 C.

Line Towers.

The Structural Design of Towers for Electric Power-Transmission Lines. Joseph Mayer. Discusses the forces acting on the towers through wind presssure, ice load, and longitudinal forces; the types of foundations, design, &c. Ills. 6500 w. Eng News—Jan. 4, 1906. No. 74169.

Progress.

Power Transmission in 1906. Dr. F. A. C. Perrine. Calls attention to the change of sentiment by financiers for water-power securities; and the problem of the lightning arrester, the insulator problem, &c. 1000 w. Elec Rev, N Y—Jan. 13, 1906. No. 74428.

Protective Devices.

Discussion on Lightning and Lightning Protective Apparatus. 6800 w. Am Inst of Elec Engrs—Dec., 1905. No. 74185 D.

Zambesi.

The Zambesi Power Scheme. W. B. Esson. A reply to criticisms, concluding that the undertaking is economically sound providing no difficulties prevent the fulfillment of proposed conditions. 2500 w. Elec Rev, Lond—Jan. 12, 1906. No. 74514 A.

MISCELLANY.

Efficiencies.

Efficiencies. James Swinburne. Abstract of an address to the students of the Manchester local section of the Inst. of Elec. Engrs. 3500 w. Elec Rev, N Y—Dec. 30, 1905. No. 74106.

Electrical Problems.

Unsolved Problems in Electrical Engineering. Col. Rookes Evelyn Bell Crompton. The "James Forrest" lecture, 1905. Treats a few of these problems, referring to some very near solution, and others that will greatly benefit mankind. 11000 w. Inst of Civ Engrs—April 10, 1905. No. 74354 N.

Review.

Electrical Development in Europe in 1905. C. L. Durand. A review of progress in the various electrical industries. 2000 w. Elec Rev, N Y—Jan. 13, 1906. No. 74432.

INDUSTRIAL ECONOMY

Accounting.

Cold Storage Accounting. Lamont Brace. Helpful suggestions. 1600 w. Ice & Refrig—Jan., 1906. Serial. 1st part. No. 74281 C.

China.

Anti-Foreign Agitation in China. Editorial discussion of the boycott of American goods and other matters affecting Chinese trade. 2700 w. Eng'ng—Dec. 22, 1905. No. 74153 A.

Chinese Miners.

Chinese Coolies in the Transvaal. Describes the conditions under which 45,000 Chinese coolies have been collected in China and sent to South Africa to serve as workmen in the mines. Shows the contract has been carried out in an honest manner to the advantage of all concerned. 1700 w. Eng & Min Jour—Jan. 20, 1906. No. 74473.

Coal Trade.

The Coal Trade in 1905. Editorial review of the trade of the year in Great Britain. 2000 w. Col Guard—Jan. 5, 1906. No. 74412 A.

Copper Trade.

Annual Review of the American Copper

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Trade. Horace J. Stevens. Brief review of this industry in the United States, from its earliest origin, with particulars of the production during 1905. 4000 w. Min Wld—Jan. 6, 1906. No. 74232.

Annual Review of the World's Copper Trade. Horace J. Stevens. Reports the largest yearly production ever known, with much interesting information. 3500 w. Min Wld—Jan. 13, 1906. No. 74370.

Costs.

The Estimation of Costs. A. W. Farnsworth. Read before the Coventry Engng. Soc. Discusses methods of estimating, the essentials of accuracy, considering briefly how an estimate should be made. 4500 w. Engr, Lond—Jan. 19, 1906. No. 74758 A.

Education.

Is Amalgamation a Failure? L. H. Chandler. A very full exposition of the engineering training given at the Naval Academy in Annapolis. Ills. 3600 w. Pro U S Naval Inst—Dec., 1905. No. 74717 G.

Engineering Trade.

Industrial Depressions and Engineering Export and Import Trade. W. Pollard Digby. A critical statistical analysis of the sources of national prosperity and their relation to commercial fluctuations. 3500 w. Engineering Magazine—Feb., 1906. No. 74674 B.

Export Duty.

The Economic Effect of the Export Duty on Coal. Emerson Bainbridge. Aims to prove that the imposition of this tax in England has been and is a serious economic error. 3000 w. Col Guard—Jan. 5, 1906. No. 74413 A.

Germany.

The American and the German Peril. Louis J. Magee. Mr. Magee's second article deals principally with the present German industrial policy and its ideals. 4000 w. Engineering Magazine—Feb., 1906. No. 74670 B.

Iron Trade.

The Chicago Iron Trade in 1905. A. O. Backert. Reports the projected increase in producing capacity, an unequaled buying movement, new construction materials, finished product, &c. 5000 w. Ir Age—Jan. 4, 1906. No. 74224.

The Philadelphia Iron Trade in 1905. Thomas Hobson. Gives a cheerful forecast for 1906, considering prices, materials, &c. 4000 w. Ir Age—Jan. 4, 1906. No. 74225.

The Pittsburg Iron Trade in 1905. Robert A. Walker. A review of the year, reporting new construction, price agreements, labor matters, materials, coke, and finished iron and steel. 6400 w. Ir Age—Jan. 4, 1906. No. 74223.

Labor.

Better Methods of Compensation for Workmen. George W. Dickie. Discusses present systems and their disadvantages, and outlines a system of contracting for the labor as a whole with the workmen, urging its advantages. 6000 w. Cassier's Mag—Jan., 1906. No. 74460 B.

Dr. Wm. Jacks on Labor Problems and Legislation. Interesting remarks on the problems of trade disputes and industrial coöperation. 2300 w. Ir & Coal Trds Rev—Jan. 19, 1906. No. 74760 A.

Mining Industry.

I. Copper. Frederick Hobart. II. Copper in Arizona in 1905. James Douglas. III. The Lake Superior Copper District. C. E. Thomas. The papers reviewing the history of copper for the year, the production prices, &c. 6800 w. Eng & Min Jour—Jan. 6, 1906. No. 74253.

I. Gold and Silver. Frederick Hobart. II. Commercial Movement of Gold and Silver in 1905. A. Selwyn-Brown. Yearly reports of production and demand. 2500 w. Eng & Min Jour—Jan. 6, 1906. No. 74252.

Iron and Steel. Reports concerning this industry from Frederick Hobart. L. W. Friedman, E. Morrrison, George H. Cushing, E. F. Luty and Dwight E. Woodbridge, covering the various districts. 1400 w. Eng & Min Jour—Jan. 6, 1906. No. 74271.

I. Lead. W. R. Ingalls. II. The Coeur D'Alene in 1905. Stanley A. Easton. III. The Southeast Missouri Lead District. H. A. Wheeler. A review of the year. 4500 w. Eng & Min Jour—Jan 6, 1906. No. 74254.

Ore Deposits and Industrial Supremacy. John L. Steward. Considers the influence of economic geology on the industrial stability of the country. 2800 w. Ec Geol—Dec., 1905. No. 74707 D.

I. Zinc. W. R. Ingalls. II. The Joplin District. Jesse A. Zook. III. Virginia Lead and Zinc Mining in 1905. J. A. Van Mater. IV. Zinc Mining in Wisconsin in 1905. E. W. Moore. A yearly review of the zinc industry in the various districts. 6400 w. Eng & Min Jour—Jan. 6. 1906. No. 74255.

Patents.

Patents in Their Relation to the Gas Engine and the Automobile. S. M. Howell. The writer has given much time to the study of the priority of patents of this class, and aims to give some helpful information on this subject. Ills. 2200 w. Mach. N Y—Jan., 1906. Serial. 1st part. No. 74115 C.

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Pig Iron.

The Southern Pig Iron Market in 1905. James A. Green. A review of the year by months. 4500 w. Ir Age—Jan. 11, 1906. No. 74303.

Selling.

How Machine Tools Are Sold. A conversation between Mr. H. F. Frevert, who has had many years' experience of trade conditions on both sides of the Atlantic, and the publisher. 4400 w. Mach, N Y—Jan., 1906. No. 74116 C.

Shop Hygiene.

Recent Improvements in the Hygiene of Workshops (Les Améliorations Récentes dans l'Hygiène des Ateliers). Paul Razous. Discussing especially appliances for the removal of dust, gases, and injurious vapors from workrooms. Two articles. 5000 w. Génie Civil—Jan. 6, 13, 1906. No. 74633 each D.

Tin Plate.

The Sheet and Tin Plate Trade. B. E. Luty. A review of the phenomenal increase in production, comparing with the previous year, and discussing prices, labor, competition, &c. 3500 w. Ir Age—Jan. 11, 1906. No. 74302.

Transportation Costs.

The Cost of Transportation of the Raw Materials in the Iron Industry (Die Rohstoff-Gütertarife der Eisenindustrie). E. Schrödter. A comparative review of the cost of railway transport of iron ore in the principal manufacturing countries, showing the importance of a reduction in rates in Germany. 10000 w. Stahl u Eisen—Dec. 15, 1905. No. 74642 D.

Works Management.

The Square Deal in Works Management. O. M. Becker. Mr. Becker's second paper discussses the methods which may be employed in the betterment of the plant itself, with numerous illustrations. 5000 w. Engineering Magazine—Feb., 1906. No. 74672 B.

Zinc.

The Zinc Industry in Silesia in 1905. Paul Speier. Reviews the business of the year, and calls attention to the change in zinc smelting practice gradually taking place, from the old type of furnace to the Rhenish type. Also editorial. 2000 w. Eng & Min Jour—Jan. 27, 1906. No. 74730.

MARINE AND NAVAL ENGINEERING

Barges.

Steel Barges. Richard J. Donovan. Gives statements concerning river transportation, the character of the business and methods of handling, the types of carriers, &c., illustrating and describing the typical river steamboat and steel barge. Discussion. 4000 w. Pro Engrs' Soc of W Penn—Jan., 1906. No. 74542 D.

Coaling.

Floating Depot for Coaling Warships. Day Allen Willey. Illlustrates and describes the floating depot placed in service by the British Admiralty, and the methods used for loading and unloading. 800 w. Sci Am—Jan. 20, 1906. No. 74439.

Docks.

A New Graving Dock at Nagasaki, Japan. Continued discussion of the paper by Naoji Sheraishi. 3000 w. Pro Am Soc of Civ Engrs—Jan., 1906. No. 74703 E.

The Cavité Drydock. Day Allen Willey. An illustrated article giving report of tests made and the arrangements for towing the structure to the Philippines. 1600 w. Sci Am—Jan. 6, 1906. No. 74195.

Liner.

Cunard Turbine Liner Carmania. Illustrated detailed description of this large turbine steamer, its equipment, and report of trials. 8200 w. Marine Rev—Jan. 4, 1906. No. 74238.

Marine Registry.

Bureaus for the Classification of Ships (Les Offices de Classification de Navires). An account of the origin and operations of the Bureau Veritas and of Lloyds, in the classification and registry of vessels. 3000 w. Génie Civil—Dec. 30, 1905. No. 74631 D.

Merchant Marine.

The Merchant Marine as an Auxiliary to the Navy. Report of Admiral George Dewey, President-General Board, Navy Department, to the Secretary of the Navy. 2000 w. Naut Gaz—Dec. 28, 1905. No. 74110.

Upbuilding of Our Merchant Marine. F. W. Hibbs. Urging the establishing of the American merchant marine on an equal footing with other nations. 3800 w. Marine Rev—Dec. 28, 1905. No. 74096.

Motor Boats.

Review of the 1905 Autoboat Season. W. P. Stephens. A review of the races, regattas, carnivals, &c. 3000 w. Automobile—Jan. 11, 1906. No. 74361.

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Propulsion.

The "Motogodille," a Motor Device for Propelling Small Boats. Illustrated description of an inexpensive and simple method of applying a small gasoline motor to boats. 500 w. Sci Am Sup—Jan. 27, 1906. No. 74574.

Scouts.

H. M. S. Attentive. Illustration, description, and report of trial. 700 w. Engr, Lond—Dec. 22, 1905. No. 74157 A.

Scout Vessels for the United States Navy. Lieut. H. C. Dinger. Discusses the speed, endurance, and reliability of these vessels, their armament, habits, ability, structural strength, machinery, &c. 3800 w. Marine Rev—Jan. 11, 1906. No. 74343.

Shipbuilding.

A New and Interesting Overhead Traveling Gear for Expediting Construction in Shipyards. Illustrates and describes a new system recently erected in a British yard, which is able to serve every part of the berth. 1000 w. Sci Am—Jan. 27, 1906. No. 74570.

A Shipbuilding Cableway. Illustrated detailed description of an ingenious application of the cableway to the building of ships, in use at Jarrow-on-Tyne. 1500 w. Engr, Lond—Jan. 19, 1906. No. 74757 A.

Shipbuilding and Marine Engineering in 1905. A review of these industries in the United Kingdom. 4000 w. Engr—Jan. 5, 1906. Serial. 1st part. No. 74419 A.

Shipbuilding for the Navy. Lord Brassey. Discusses the naval requirements of Great Britain, favoring the building of smaller vessels, distributing the guns in more ships. Abstract of discussion. 20500 w. Inst of Civ Engrs (No. 3562). No. 74357 N.

Shipping.

The American Shipping Question. Col. Robert J. Lowry. A discussion of conditions in the past and present, and the action needed to restore American mercantile ships to the seas. 1800 w. Marine Rev—Jan. 18, 1906. No. 74467.

Signaling.

Submarine Signaling. Henry R. Gilson. Reviews the experimental investigations made during the last twenty years in this field, especially the success attained by American investigators, describing the present signaling system and explaining some of the uses to which it may be applied. Ills. 6500 w. Tech Qr—Dec., 1905. No. 74585 E.

Sounding.

A Long Wire Sweep for Soundings. D. B. Wainwright. Describes a sweep used in Frenchman's Bay, Me., and its operation. 1500 w. Eng Rec—Jan. 20, 1906. No. 74504.

Steamboat.

Magnificent Steamboat for Great Lakes. Illustrations and brief description of a 400-ft. passenger steamboat to be built for the Detroit and Cleveland Nav. Co. 700 w. Naut Gaz—Jan. 18, 1906. No. 74483.

Steamer.

The Steamer Hoover and Mason. Illustrated description of the new lake ore carrier having transverse hoppers. 1100 w. Ir Age—Jan. 4, 1906. No. 74216.

Submarines.

Submarines. J. H. Tomb. A brief description of types, operations of, and accidents to submarines. 2200 w. Pro U S Naval Inst—Dec., 1905. No. 74718 G.

Subsidies.

Shipping Subsidies. Royal Meeker. Abstract of an article in the *Pol. Sci. Qr.* A discussion of the subject of subsidies, concluding that there is no good economic reason for granting subsidies to the merchant marine either for construction or navigation. 3800 w. R R Gaz—Vol. XL, No. 3. No. 74456.

Torpedo.

The New Turbine Torpedo of the United States Navy. Illustrated description of the Bliss Leavitt Model. 1800 w. Sci Am—Jan. 6, 1906. No. 74194.

Torpedo Boats.

Torpedo Craft for Scouting Purposes. Reviews the performance of this class of vessels, and discusses their fighting value, their requirements under the changed conditions, and the possibility of combining the qualities of torpedo craft and scouting vessels. 1500 w. Engr, Lond—Jan. 5, 1906. No. 74425 A.

Turbine Steamer.

The Largest Turbine Steamship in the World. Archibald S. Hurd. A finely illustrated article giving a detailed description of the "Carmania" of the Cunard Line. 2000 w. Cassier's Mag—Jan., 1906. No. 74459 B.

The Trans-Atlantic Turbine Steamer Carmania (Der Trans-Atlantische Turbinendampfer Carmania). W. Kaemmerer. A general description of the propelling machinery, in comparison with that of the Caronia. 2500 w. Zeitschr d Ver Deutscher Ing—Jan. 6, 1906. No. 74607 D.

The Turbine Steamer Carmania (La Paquebot à Turbines Carmania.) L. Piaud. A fully illustrated general description of the new Cunard liner and her machinery. 2500 w. 1 plate. Génie Civil—Jan. 6, 1906. No. 74632 D.

Warships.

Warship Construction. A review of warship construction during 1905 in Great Britain. 3800 w. Engng—Dec. 29, 1905. No. 74297 A.

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MECHANICAL ENGINEERING

AUTOMOBILES.

Ball-Bearings.

The Hoffman Ball-Bearings for Motor Cars. An illustrated article describing these bearings and the ball-bearing hub for cars of different types. 3000 w. Auto Jour—Jan. 13, 1906. Serial. 1st part. No. 74507 A.

Brakes.

Brakes of Various Types and Their Use. Maurice Pardet. Discusses various systems of braking in present use. 2000 w. Automobile—Jan. 4, 1906. No. 74205.

Methods in Brakes Seen at the Shows. Illustrated descriptions of interesting types. 1400 w. Automobile—Jan. 25, 1906. No. 74577.

Clutches.

Improved Transmissions and Clutches. Illustrates and describes interesting improvements noticed at the recent New York shows. 5000 w. Automobile—Jan. 25, 1906. No. 74576.

Commercial Vehicles.

The Fiat Commercial Vehicles. Illustrates and describes some details of these cars. 900 w. Auto Jour—Jan. 13, 1906. No. 74506 A.

Electric Vehicles.

Electromobiles. Henry F. Joel. A critical review of an article by Frank B. Rae on "Speed-time Curves for Automobile Motors," published in the *Electrical World and Engineer*. 1500 w. Elec Rev, Lond—Dec. 29, 1905. No. 74289 A.

Energy Consumed by Electric Automobiles. Alex. Churchward. Reports tests made with a special graphic recording meter designed by the General Electric Co. 900 w. Automobile—Jan. 11, 1906. No. 74360.

Engines.

Two-Cycle and Four-Cycle Engines. C. P. Malcolm. A discussion of the merits and demerits of the four-cycle and of the two-cycle engines. 3500 w. Automobile—Jan. 11, 1906. Serial. 1st part. No. 74358.

Exhibitions.

Cars and Airships at the Armory. An illustrated account of the opening of this show, describing some of the exhibits. 12500 w. Automobile—Jan. 15, 1906. No. 74450.

Garden Show a Beautiful Spectacle. An illustrated article describing some of the exhibits, their arrangement, and the scheme of decoration. 7800 w. Automobile—Jan. 18, 1906. No. 74449.

French Designs.

Comparative Analyses of French Design. W. F. Bradley. A comparative analysis of the 326 French cars shown at the Paris salon. 1000 w. Automobile—Jan. 11, 1906. No. 74359.

Motor Car Progress in France. The present article discusses the perturbed condition of the French industry and its causes, comparing English with French progress. 2000 w. Engr, Lond—Dec. 22, 1905. Serial. 1st part. No. 74156 A.

Ignition.

Ignition Practice at the Shows. An illustrated review of European and American practice as noticed at the recent exhibitions. 5500 w. Automobile—Jan. 25, 1906. No. 74578.

Lanchester.

The Twenty H. P. Four-Cylinder Lanchester. Illustrates and describes the engine, the countershaft, and the change speed mechanism. 1000 w. Autocar—Jan. 6, 1906. No. 74398 A.

Locomobile Models.

Locomobile Features of Construction. Illustrates and describes details of the two models for 1906. They are side-entrance touring cars, side-chain driven, with four-cylinder vertical water-cooled motors. 3000 w. Automobile—Jan. 4, 1906. No. 74206.

Magneto.

The Holley High-Tension Magneto. Illustrated description of a particularly interesting magneto. 1400 w. Automobile—Jan. 11, 1906. No. 74364.

Modern Cars.

"Small" and "Popular-Priced" Cars. Rene M. Petard. Begins an illustrated discussion of modern cars of the types named. 2200 w. Automobile—Jan. 15, 1906. Serial. 1st part. No. 74451.

Motor Cooling.

Motor Cooling Principles and Practices. L. M. Dieterich. An explanation of the characteristics of heat-conditions existing in an automobile gasoline motor, and the

We supply copies of these articles. See page 957.

forms of cooling. 4400 w. Automobile—Jan. 11, 1906. No. 74363.

Napier.

The 1906 Six-Cylinder Napier Cars. An illustrated article giving detailed information concerning the construction of these cars. 1000 w. Auto Jour—Jan. 13, 1906. Serial. 1st part. No. 74505 A

1906 Models.

1906 Models at the Paris Salon Rene M. Petard. Begins an illustrated description of many of the new models shown. 1700 w. Automobile—Dec. 28, 1905. Serial. 1st part. No. 74204.

Omnibuses.

The Automobile Omnibuses of the General Omnibus Company of Paris. (Les Omnibus Automobiles de la Compagnie Générale des Omnibus à Paris). Col. G. Espitallier. A fully illustrated description of several types of omnibus under practical test in the public service in Paris. 3000 w. Génie Civil—Dec. 30, 1905. No. 74629 D.

Paris Exhibition.

Novelties at the Paris Automobile Show. Illustrated descriptions of cars, motor boat, and new searchlight. 2700 w. Sci Am Sup—Jan. 27, 1906. No. 74573.

Patents.

See Industrial Economy

Petrol-Electric.

The Auto-Mixte Petrol-Electric Car. Brief ilustrated description of the Auto-Mixte system, exhibited at the Paris Salon. 700 w. Auto Jour—Jan. 6, 1906. No. 74394 A.

Richard-Brasier.

The Richard-Brasier Cars of 1906. Illustrates and describes the new features introduced. 1000 w. Auto-car—Jan. 6, 1906. Serial. 1st part. No. 74396 A.

Talbot.

The 20 H. P. British Built Talbot Car. An illustrated article describing the engine, clutch, gear-box, etc. 1200 w. Autocar—Jan. 20, 1906. No. 74732 A.

Testing Plant.

Automobile Testing Plant at Purdue University. Brief illustrated description 500 w. R R Gaz—Vol. XL. No. 4. No. 74583.

Touring Cars.

Dorris Touring Car Makes Its Debut. An illustrated description of a modern touring type, having a 4-cylinder vertical water-cooled motor of 26-30 h. p., sliding gear transmission and shaft and bevel gear drive. 1200 w. Automobile—Jan. 11, 1906. No. 74362.

High-Powered American Touring Cars. Illustrates and describes numerous types. 6500 w. Sci Am—Jan. 13, 1906. No. 74392.

Trembler Coils.

Adjustment of Quick-Acting Trembler Coils. W. H. Glaser. An explanation of the mode of action and especially describing the easiest and best way of making the adjustment in practice. 1200 w. Autocar—Jan. 6, 1906. No. 74397 A.

COMBUSTION MOTORS.

Cylinder Cooling.

A Rational Method of Cooling Gas-Engine Cylinders. S. M. Howell. Shows the disadvantages of water cooling and describes a novel water-jacketed, high-pressure cylinder for a compound gas engine, stating the advantages claimed. 1800 w. Sci Am—Jan. 20, 1906. No. 74441.

Gas Cleaning.

Methods of Cleaning Furnace Gases (Ueber den Gegenwärtigen Stand der Gichtgasreinigung). F. J. Meyjes. Illustrating a number of recent devices for washing furnace discharge gases to remove the dust and clean it for use as fuel for gas engines. 2500 w. Stahl u Eisen—Jan. 1, 1906. No. 74647 D.

Gas Engines.

The Oechelhauser Gas-Engine. Illustrated detailed description of this large internal-combustion engine for utilizing the waste gases of blast furnaces and for working with producer gas. 2700 w. Engng—Jan. 5, 1906. Serial. 1st part. No. 74416 A.

Union Gas Engine of 250 Horse Power (Moteur à Gaz Union de 250 Chevaux). L. Ramakers. Illustrated description of horizontal double-acting gas engine, exhibited at Liége. 1000 w. 1 plate. Génie Civil—Dec. 30, 1905. No. 74630 D.

Gas Producer.

Gas Producer for Use with Mineral Oil (Gasogène pour Huiles Minérales). A description of the Lazareff gas producer for the direct conversion of heavy mineral oils into illuminating and fuel gas. 1200 w. Génie Civil—Dec. 16, 1905. No. 74625 D.

Gas Turbines.

The Question of the Gas Turbine. Robert M. Neilson. With commentary by Henry F. Schmidt. Discusses the probability of making the gas turbine a commercial success, and the difficulties of the problem. 2000 w. Power—Jan., 1906. No. 74127 C.

Patents.

See Industrial Economy.

Power Plants.

Modern Gas Engine Power Plants. Franz Koester. Gives illustrations of a number of large plants, with a brief review of the development of the gas engine. 1800 w. Eng Rec—Jan. 6, 1906. No. 74276.

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Safety Factor.

The Choice of a Factor of Safety for a Machine Member. Forrest E. Cardullo. A discussion of the apparent factor of safety, and the factors which compose it, outlining the method of development, and illustrating by examples. 3300 w. Mach, N Y—Jan., 1906. No. 74114 C.

See also Mechanical Engineering, Automobiles.

HEATING AND COOLING.

Auditorium.

Heating and Ventilating the Main Auditorium of the Broadway Tabernacle, New York. C. Terau. Describes the conditions, and the installation of a blast system, with mechanical exhaust and automatic temperature control. 1600 w. Am Soc of Heat & Vent Engrs—Jan., 1906. No. 74337 C.

Drying.

Notes on Drying Plants (Einiges über Trockenanlagen). Karl Reyscher. A discussion of the best method of arranging the air circulation in the design of drying kilns. 3000 w. Zeitschr d Ver Deutscher Ing—Dec. 23, 1905. No. 74602 D.

Exhaust Steam.

Exhaust Steam for Heating Buildings. An illustrated discussion of systems which utilize steam for heating, the piping systems, &c. 2200 w. Engr, U S A —Jan. 1, 1906. Special No. No. 74324 D.

Franklin.

Benjamin Franklin, the First American Heating and Ventilating Engineer. Albert A. Cary. Address before the Am. Soc. of Heat. & Vent. Engrs. Considers Franklin's Pennsylvania fireplace, and his theory of heat, with his views concerning the prospects of obtaining coal for fuel in the United States. 3800 w. Eng Rec —Jan. 27, 1906. No. 74767.

Heat Insulation.

Heat Insulation; Its Principles as Related to Cold Storage Practice. J. B. d'Homergue. Treats of insulation as bearing directly on artificial refrigeration, the materials used; with report of tests carried out at Purdue University, the apparatus and methods employed, &c. Discussion. Ills. 9000 w. Pro Engrs' Soc of W Penn—Jan., 1906. No. 74543 D.

Hospital Heating.

Heating and Ventilation of St. Paul's Hospital, Montreal, Que. Alan G. McAvity. Describes the system installed, outlining the ideal aimed at, and discussing the efficiency of the installation. Ills. 3000 w. Can Soc of Civ Engrs—Jan. 18, 1906. No. 74763 D.

Hotel Plant.

Some Features of the Heating and Ventilating System of the Bellevue-Stratford Hotel, Philadelphia. William G. Snow. Exhaust steam is used for heating. The distributing system is described, and other features of interest. 3500 w. Am Soc of Heat & Vent Engrs—Jan., 1906. No. 74339 C.

Refrigeration.

Needed Improvements in the Transportation of Perishable Fruits: A Refrigeration Problem. Extracts from a paper by G. H. Powell. Discusses the difficulties of distribution in the fruit trade. 1600 w. Eng News—Jan. 4, 1906. No. 74176.

Return Pipes.

Sizes of Return Pipes in Steam Heating Apparatus. Jas. A. Donnelly. Considers the functions of return pipes and methods of proportioning. 3000 w. Am Soc of Heat & Vent Engrs—Jan., 1906. No. 74334 C.

Schoolhouses.

Schoolhouse Warming and Ventilation. Charles L. Hubbard. An actual installation of an indirect gravity steam heating system is discussed and illustrated. 2000 w. Met Work—Jan. 6, 1906. Serial. 1st part. No. 74186.

Warming and Ventilating a Schoolhouse at Pelham, N. Y. C. T. Richards. Illustrated description of a gravity system of furnace heating in a four-room building. 1700 w. Met Work—Jan. 13, 1906. No. 74328.

Steam Heating.

A New Vapor-Vacuum System of Steam Heating. Jas. A. Donnelly. Illustrated description of a system designed to work under the same principles as those governing mechanical circulations, where a vacuum pump is usually used upon the main return. 1000 w. Am Soc of Heat & Vent Engrs—Jan., 1906. No. 74336 C.

Heating with Ventilation. Discusses systems of heating where ventilation is also required, and methods of determining the sizes of pipes, amount of air, and other requirements. Ills. 2000 w. Special No. Engr, U S A—Jan. 1, 1906. No. 74325 D.

Ventilation.

Arrangements for the Ventilation of the Debating-Rooms of the New Riksdag's Building in Stockholm, and the Results Obtained in this Respect. William Dahlgren. Discusses whether upward or downward ventilation is more satisfactory. Both were tried and the upward system retained. Ills. 2800 w. Am Soc of Heat & Vent Engrs—Jan., 1906. No. 74335 C.

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HYDRAULICS.

Centrifugal Pumps.

Test of a Three-Stage, Direct-Connected, Centrifugal Pumping Unit. Philip E. Harroun. Notes illustrating test, presented to draw out a general discussion at next meeting. Also short discussion. Ills. 4000 w. Pro Am Soc of Civ Engrs—Dec., 1905. No. 74094 E.

The Latest Developments of the Rateau High-Pressure Centrifugal Pump (Die Neuesten Ausführungstypen der Hochdruck Kreiselpumpe System Rateau). Julius Divis. Data concerning recent performances of multiple centrifugal pumps. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Dec. 16, 1905. No. 74650 D.

Flow.

Researches for the Determination of a Formula for the Flow of Water over Natural River Beds (Versuch der Aufstellung einer Geschwindigkeitsformel für natürliche Flussbette). Maximilian Matakiewicz. Tables and diagrams for the determination of coefficients and exponents for use with the modified Chézy formula. 4000 w. Oesterr Monatschr f d Oeffent Baudienst—Dec. 23, 1905. No. 74667 D.

Hydro-Electric Stations.

See Electrical Engineering, Generating Stations.

Pumping Plant.

Electric Motor Centrifugal Pumping Plant for Draining the Torresdale Tunnel, Philadelphia. Illustrates and describes a simple and efficient pumping plant, comprising as its distinctive elements, two high speed DeLaval electric motor centrifugal pumps, which promises wide usefulness in shaft sinking operation. 1200 w. Eng News—Jan. 25, 1906. No. 74568.

Electric Pumping Plant at Consett Ironworks. An illustrated description of the scheme adopted, the pumps having a capacity of nearly 8,600,000 gallons of water pumped in twenty-four hours. 2500 w. Engr, Lond—Jan. 12, 1906. No. 74526 A.

Turbines.

German Turbines at Niagara (Deutsche Turbinen am Niagara). Albert Ungerer. With illustrations and descriptions of the Francis type of turbines built by Voith, of Heidenheim, Würtemberg, for the Hamilton, and the Ontario Power Companies at Niagara Falls. 2500 w. Zeitschr d Ver Deutscher Ing—Dec. 16, 1905. No. 74600 D.

Studies upon the Pressure on the Step Bearing of the Vertical Shaft of the Francis Turbine (Studien über den Druck auf den Spurzapfen der Francis Turbinen mit Lotrechter Wellen) Dr. Karl Kobes. A mathematical discussion of the action of weight and water pressure upon the pivot of the vertical shaft in turbines of the Francis type. Serial. Part I. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—Jan. 12, 1906. No. 74641 D.

The Best Point for Pivoting Turbine Guide Buckets (Experimentelle Bestimmung des Günstigen Drehpunktes von Turbinendrehschaufeln) Dr. R. Camerer. Describing experiments to determine the action of the hydraulic forces on turbine guides to find the best position for pivoting with respect to ease of movement. 1500 w. Zeitschr d Ver Deutscher Ing—Jan. 13, 1906. No. 74611 D.

Waves.

The Theory of the Propagation of a Single Wave along a Horizontal Elastic Tube (Théorie de l'Onde Solitaire qui se Propage le Long d'un Tube Elastique Horizontal). A. Boulanger. A mathematical examination of the propagation of the impulse produced in a tube filled with liquid and suddenly compressed at one end. 1500 w. Comptes Rendus—Dec. 11, 1905. No. 74638 D.

See Civil Engineering, Water Supply.

MACHINE WORKS AND FOUNDRIES.

Appliances.

Two Novel Workshop Appliances. Illustrates and describes a modern hand-planing tool, and an adjustable die stock. 600 w. Mech Engr—Jan. 13, 1906. No. 74508 A.

Bessemer.

The Value of the Small Bessemer Plant in the Machine Works (Die Bedeutung der Kleinbessemerei für die Eisenhüttenindustrie und den Maschinenbau). Hans van Gendt. A discussion of the extent to which a small Bessemer converter may be economically employed in the ordinary foundry. 3000 w. Stahl u Eisen—Dec. 15, 1905. No. 74643 D.

Car Wheels.

Machine Molding and Continuous Casting of Car Wheels. Illustrated detailed description of the process as carried out at the plant of the American Car & Foundry Co., Terre Haute, Ind. 3000 w. Ir Age—Jan. 4, 1906. No. 74214.

Cast Iron.

Cast Iron in the Foundry. Percy Longmuir. Presents some aspects of foundry practice in the mixing, melting and molding of castings. Ills. 5000 w. Jour of W of Scotland Ir & St Inst—Dec., 1905. No. 74720 D.

Costs.

Foundry Costs. Ellsworth M. Taylor. Read at the A. F. A. convention. The importance of accurate cost methods are set forth, and an outline given, covering

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in a general way the vital points in regard to foundries. 3500 w. Foundry—Jan, 1906. No. 74557.

Crushing Mills.

Sugar-Cane Crushing Mill. An illustrated detailed description of a fine example of this class of machinery built for British Guiana. 2000 w. Engr, Lond—Jan. 12, 1906. No. 74527 A.

Drilling Machine.

Horizontal Drilling and Boring Machine. Illustrated description of a fine machine tool recently built in England. 700 w. Engr, Lond—Jan. 5, 1906. No. 74424 A.

Fan-Blowers.

The Conditions of Fan-Blower Design. Walter B. Snow. An explanation of the forces to be considered in the design of various types. 2500 w. Cassier's Mag—Jan., 1906. No. 74463 B.

Foundries.

Fireclays and Molding Sands. Percy Longmuir. Read before the British Found. Assn. Discusses the three classes of refractory materials, both furnace materials and molding sands. 4000 w. Ir & Coal Trds Rev—Jan. 12, 1906. No. 74529 A.

Heating and Ventilation of Foundries. Harry Malone. Briefly considers different systems of heating, with remarks on the difficulties peculiar to the work. 1000 w. Foundry—Jan, 1906. No. 74560.

The Foundry on a Chemical Basis. Reginald Meeks. Considers how to use a chemist to advantage, specifications for ordinary foundry iron, sampling, figuring the mixture, the chemists' report, steels, etc. 4000 w. Ir Age—Jan. 4, 1906. No. 74218.

Galvanizing.

Galvanizing. Dr. R. Moldenke. Gives an outline of the galvanizing process as now carried on. 1500 w. Foundry—Jan. 1906. No. 74558.

Indexing.

A Drawing Record and Indexing System. Brief description of records kept for machine tool repairs. 900 w. Am Mach—Vol. 29. No. 2. No. 74318.

Iron Works.

Some Notes on a Visit to Iron and Steel Works in the United States and Canada. P. N. Cunningham. Deals with the transportation, handling, and assembling of material in iron and steel works, and the accessories connected with such plants. Ills. Discussion. 10600 w. Jour of W of Scotland Ir & St Inst—Nov, 1905. No. 74719 D.

Lathes.

Large Electrically Driven Lathes. Frank C. Perkins. Illustrated descriptions of several electrically operated lathes, and the systems for working them. 2200 w. Ir Age—Jan. 4, 1906. No. 74221.

Machine Design.

The Design of a Combined Punching and Shearing Machine. Gives the specification and illustrated description of the design. 1000 w. Am Mach—Vol. 29. No. 2. No. 74319.

Manufacturing Plants.

Manufacturing Buildings in Cities. Walter S. Timmins. Discusses location, rents and power, forms of construction, vibration, fire proof qualities, costs of reinforced concrete, insurance on manufacturing plants, and power plants. Ills. 3800 w. Ir Age—Jan. 4, 1906. No. 74220.

Milling Machines.

English Beam-End Milling Machines. Illustrated description of large machines especially designed for milling the ends of beams of various sections. 900 w. Am Mach—Vol. 29. No. 2. No. 74316.

Molding.

Manipulation of Molding Sand. Mr. Vroman. Read before the Chicago Foundry Foremen. Discusses the manufacture and its cost, and shows that through manipulation many of the faults of molding sand can be removed. 1500 w. Foundry—Jan, 1906. No. 74559.

Permanent Molds and Carbon Cores. Henry C. Caldwell. Read before the Phila. Found. Assn. Discusses the obstacles encountered and gives a report of the experiments and final success with carbon molds and core boxes. 1600 w. Ir Age—Jan. 18, 1906. No. 74435.

Patterns.

Curves in Pattern-Work. From the *English Mechanic and World of Science.* An illustrated article giving suggestions for the making of curved patterns so as to diminish shrinkage and twist. 2000 w. Sci Am Sup—Jan. 6, 1906. No. 74196.

Pickling.

The Injurious Effect of Acid Pickles on Steel. Prof. Charles F. Burgess. Discusses the influence which such treatment exerts on the physical properties; giving a report of investigations carried out at the University of Wisconsin. Ills. 4400 w. Elec-Chem & Met Ind—Jan, 1906. No. 74240 C.

Pipe Fittings.

Piping History Repeating Itself. James Acton Miller. Refers to the use of wrought pipe bends and the saving in cost and greater safety secured; also improvements in joints and other bending work. Ills. 1500 w. Ir Age—Jan. 18, 1906. No. 74434.

Power Required to Thread, Twist, and Split Wrought Iron and Mild Steel Pipe.

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I. N. Thomson. Discusses materials used, giving tabulated results of tests, the dies used, and the importance of correctly made dies, and the subject generally. 6000 w. Am Soc of Heat & Vent Engrs—Jan, 1906. No. 74340 C.

Pipes.

Deformations from the Combined Action of Internal Pressure and Bending under Tension or Compression (Zur Einbeulung bei Innenpressung und Biegung bei Zug oder Druck). Dr. Ph. Forchheimer. A mathematical investigation of the action of external forces upon tubes subjected at the same time to internal pressure. 1200 w. Zeitschr d Ver Deutscher Ing—Jan. 13, 1906. No. 74613 D.

Pneumatic Tools.

Applications of Pneumatic Power in the Machine Shop. R. Emerson. A well illustrated article discussing practical points in the installation, use, and care of air tools. 3000 w. Engineering Magazine. —Feb. 1906. No. 74676 B.

Rolling Mills.

Recent Improvements in Rolling Mills and Connections (Ueber Neuere Konstruktionen an Walzwerksantrieben und Zwischengliedern). H. Ortmann. Discussing especially the gearing and flexible coupling connections for transmitting the power to heavy rolls. 3500 w. Stahl u Eisen—Jan. 1, 1906. No. 74646 D.

Sand Mixing.

Sand-Mixing Appliances in the Foundry. E. L. Rhead. Illustrates and describes some mechanical appliances for this work. 2000 w. Mech Engr —Jan. 6, 1906. No. 74401 A.

Screws.

Some Objections to the Commercial Fillister and Flat-Head Screws. Suggests an improvement in screws used in building machinery. 500 w. Am Mach—Vol. 29. No. 2. No. 74320.

Springs.

Formulæ for Helical Springs. A. Inokuty. Develops formulæ for helical springs made of round steel wires, of square steel wires, and steel wires of rectangular section. 1000 w. Prac Engr—Jan. 5, 1906. No. 74400 A.

Throttle Valve.

Pattern for a Throttle Valve Body. H. J. McCaslin. Illustrates and describes the method used in constructing a pattern for a three way, 12 x 12 x 14½ in. throttle valve. 900 w. Foundry—Jan., 1906. No. 74556.

Tire Turning.

Tire Turning Extraordinary. George S. Hodgins. Report of a test showing the capabilities of a new driving wheel lathe carried out at the West Albany shops of the N. Y. C. R. R. Ills. 1200 w. Ry & Loc Engng—Jan, 1906. No. 74202 C.

Type-Casting.

The Pearson Type Casting Machine. Illustrated description of a simple machine for composing advertising matter. 1700 w. Ir Age—Jan. 11, 1906. No. 74301.

Welding.

The Autogenous Welding of Metals (Die Autogene Schweissung der Metalle). E. Wiss. Describing the use of the oxy-hydrogen and oxy-acetylene blow-pipes for welding metallic structures. 3500 w. Zeitschr d Ver Deutscher Ingenieure—Jan. 13, 1906. No. 74610 D.

Works.

The Works of the New Arrol-Johnston Car Co., Ltd., Paisley. Illustrates and describes these works in detail. They are exceptionally well equipped and have many interesting features. 2500 w. Engng—Dec. 22, 1905. No. 74152 A.

Works Management.

See Industrial Economy.

MATERIALS OF CONSTRUCTION.

Bending.

A New Machine for Bending Tests. E. Probst. Illustrates and describes a machine in use in the Institute for the Testing of materials, in Zürich. 1000 w. Eng Rec—Jan. 13, 1906. No. 74388.

Black Finish.

Production of a Black Finish on Iron and Nickel. From the *Brass World*. Describes articles having a lustrous black finish said to be produced by a solution of nitrate of lead and nitrate of ammonia in connection with the electric current. 1400 w. Mech Engr—Jan. 20, 1906. No. 74734 A.

Boiler Materials.

Materials for Boilers. J. Rowland Brown. Read before the Ohio Soc. of Mech., Elec., and Steam Engrs. Present practice in the design of boilers is discussed, and the four classes of specifications of materials of boilers. Steel boiler plate, rivet steel, tubes, wrought steel, cast steel, and cast iron pressure parts are considered. 5500 w. Boiler Maker—Jan., 1906. No. 74162.

The Formation of Cracks in Boiler Plates (Die Bildung von Rissen in Kesselblechen). C. Bach. A study of the causes of cracks in boilers based upon data of the German boiler inspection associations; with illustrations and tabular results of tests. 5000 w. Zeitschr d Ver Deutschr Ing—Jan. 6, 1906. No. 74605 D.

Crushing.

Crushing Tests of the Diamonds Used in Drilling. Prof. Alexander N. Mitinsky.

Reports tests made, the results leading to the conclusion that the pressure on drilling-tools can safely be made heavier, and give an increased gain in speed of drilling. 700 w. Am Inst of Min Engrs—Jan., 1906. No. 74710.

Lubricants.

Government Tests of Lubricating Oils. A. B. Willits. An account of the specifications for lubricating oil for marine machinery and the required tests, especially the gumming test, illustrating the apparatus used. 1000 w. Ir Age—Jan. 25, 1906. No. 74539.

Metallography.

Practical Notes on Metallography (Einiges aus der Metallographischen Praxis). E. Heyn. A discussion of the applications of microscopical examinations in connection with the testing of materials, as conducted in the Royal testing laboratory at Grosslichterfelde-West, near Berlin. 4000 w. 2 plates. Stahl u Eisen—Jan. 1, 1906. No. 74645 D.

Testing.

Drop Tests on Nicked Bars (Schlagbiegeproben an Eingekerbten Stäben). C. J. Snyders & P. A. M. Hackstroh. A translation from *De Ingenieur* of drop testing work on nickel steel bars, conducted by the engineer staff of the Netherland army. 5000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 22, 1905. No. 74619 D.

Testing Machine for Anchors and Chain Cables (Anker und Kettenprüfmaschine). Illustrating a 150-ton testing machine, designed to admit the anchors of ships, as well as heavy chain cables. 2000 w. Zeitschr d Ver Deutscher Ing—Dec. 23, 1905. No. 74601 D.

The Guillery Hardness-Testing Apparatus. Illustrates and describes three pieces of apparatus designed by M. Guillery, for testing hardness, elastic limit, and brittleness. 1800 w. Engng—Jan. 12, 1906. No. 74524 A.

MEASUREMENT.

Angles.

A Straight-Line Instrument for Trisecting an Angle. F. I. Llewellyn. Illustrated description of the instrument and its application. 600 w. Eng News—Jan. 4, 1906. No. 74174.

Planimeters.

The Theory of Planimeters. G. B. Upton. Aims to show that a theory of planimeters can be developed which shall be simple and general, with a minimum of mathematics. 1500 w. Sib Jour of Engng—Dec, 1905. No. 74551 C.

Recording Apparatus.

The "Ados" CO_2 Recorder. Illustrated description of a device whereby the gases in boiler flues may be analyzed and recorded automatically and continuously, explaining the principle on which it works. 2000 w. Engng—Jan. 12, 1906. No. 74523 A.

Shearing Stress.

Shear Stress and Permanent Angular Strain. W. C. Popplewell. Describes a series of experiments upon the torsional strength of solid and hollow shafts of cast iron, wrought iron and steel; and the results, so far as they relate to the elastic and ultimate strength properties of shafts, are discussed. 4000 w. Engr. Lond—Jan. 19, 1906. No. 74751 A.

Standard Measures.

History of the Standard Weights and Measures of the United States. Louis A. Fischer. Address at meeting of the Sealers of Weights and Measures of the United States at the Bureau of Standards. 7000 w. Am Mach—Vol. 29. No. 2. No. 74317.

Steam Flow.

High-Speed Outflow of Steam and Gases. Robert H. Smith. Discusses the subject in connection with the design of turbines, developing in tables and diagrams the law connecting variation of velocity and of section with the gradual fall of pressure along the axial line of the flow. 3000 w. Engr, Lond—Dec. 22, 1905. Serial. 1st part. No. 74154 A.

Vibrations.

The Measurement of Vibrations of Railway Cars. Frank C. Perkins. Illustrated description of the Sabouret pneumatic apparatus for the study of secondary movements on moving vehicles, in use in France. 1100 w. Ry Age—Dec. 29, 1905. No. 74098.

POWER AND TRANSMISSION.

Coal Handling.

From Canal Barge to Boiler Furnace by "Bennis" Automatic Machinery. Illustrates and describes several plants where this machcinery has been installed. 3500 w. Ir & Coal Trds Rev—Jan. 12, 1906. No. 74531 A.

Compressed Air.

An Air-Compressor Test. John Howatt. Gives a brief summarization of a test made at the Chicago & Great Western Railway shops at Oelwein, Iowa. 900 w. Power—Jan, 1906. No. 74128 C.

Compound Air Compression. Lucius I. Wightman. Considers the two practical methods in use for removing the heat of compression-jacket cooling, and intercooling. The gain of compound compression is discussed. 4000 w. Power—Jan, 1906. No. 74130 C.

We supply copies of these articles. See page 947.

Conveyors.

Improved Hoisting and Warehousing Equipment in Bremen (Neuere Förder und Lageranlagen in Bremen). M. Buhle. A combination plant for handling grain in bulk and also merchandise in sacks and other packages. 1500 w. Zeitschr d Ver Deutscher Ing—Jan. 6, 1906. No. 74608 D.

The 30-Ton Conveyor in the Port of Breslau (Die 30-t Entlade Anlage für Massengüter im städtischen Hafen zu Breslau). M. Buhle. Overhead cantilever trestle work, traveling crane and conveyor for handling mechandise in bulk. 1200 w. Glückauf—Dec. 23, 1905. No. 74653 D.

Cranes.

Cranes Driven by Single-Phase Motors. Illustrates and describes a four-ton single-phase electric travelling wharf-crane installed at Cologne, Germany. 1000 w. Engng—Dec. 22, 1905. No. 74150 A.

Drives.

Notes on Belt and Rope Drives. James Stormouth. Suggestions for efficient driving. 2200 w. Engr, Lond—Dec. 22, 1905. No. 74155 A.

Electric Driving.

Advantages and Applications of the Electric Drive. F. B. Crocker, and M. Arendt. Considers the one motor drive, group drive, and individual drive, and their proper application, and the advantages derived. Ills. 3000 w. Sch of Mines Qr—Nov., 1905. No. 74548 D.

Electricity in Cement Works. G. H. Oswald Strick. Describes the application of three-phase electric power to this class of work, and the process of manufacture. Ills. 2500 w. Elec Engr—Jan. 12, 1906. No. 74510 A.

Rough Notes on Electric Driving. Frank Broadbent. Discusses the rapid spread of electrical driving, its advantages, especially in the driving of printing machines. 1600 w. Elec Rev, Lond—Jan. 5, 1906. No. 74404 A.

Power.

Power in Tall Office Buildings. Charles H. Benjamin. The article deals with American conditions, discussing especially the cost, and distribution. 3300 w. Cassier's Mag—Jan, 1906. No. 74464 B.

Power Plants.

The Development of Energy in Power Plants (Energie-Erzeugung in Kraftwerken). Karl Rubricius. A comparison of the reciprocating engine, steam turbine, and gas engine as prime movers for power stations. 2000 w. Elektrotech u Maschinenbau—Jan. 7, 1906. No. 74661 D.

Shafts.

The Strength of Shafts Subject to Small Forces Rhythmically Applied. Charles Chree, Capt. Henry Riall Sankey, and William Ernest Wyatt Millington. A study of the effects of longitudinal, and of torsional vibrations, illustrating by examples. 7800 w. Inst of Civ Engrs. (No. 3558.) No. 74368 N.

STEAM ENGINEERING.

Boilers.

Boiler Corrosion. W. H. Booth. Illustrated explanation of defects found in shell boilers, where faults of construction made the action of corrosion especially dangerous. 1400 w. Power—Jan, 1906. No. 74126 C.

Safe Boilers. Roger Atkinson. A review of the development of steam boilers, discussing the elements of destruction, types, etc. 4500 w. Ry & Loc Engng—Jan, 1906. No. 74198 C.

Water Tube Boiler Designing as a Science. Elbridge Gary Robberts. Discusses points in the designing of these boilers to meet the requirements of marine practice. 1800 w. Marine Rev—Jan. 4, 1906. No. 74239.

See Mechanical Engineering, Materials.

Condensation.

Condensation of Steam. An illustrated explanation of the four classes of apparatus commonly employed for condensing exhaust steam. The surface, atmospheric, jet, and barometric or siphon condenser. 6000 w. Special No. Engr, U S A—Jan. 1, 1906. No. 74326 D.

Condensers—Types and Application. Franz Koester. Illustrated descriptions of types and applications made of them. 2500 w. Power—Jan., 1906. No. 74132 C.

Some Points on the Management of Condensers. G. P. Wright. Suggestions for the care and management. 1600 w. Special No. Engr, U S A—Jan. 1, 1906. No. 74327 D.

Economy.

Economy in Steam Power Plants. R. J. Durley. Read before the Canadian Ry Club. Considers the conditions which are favorable to the economical generation of steam, and the factors that favor economy in its utilization. 4500 w. Can Elec News—Jan, 1906. No. 74480.

Engines.

Ten-Thousand Horse-Power Rolling-Mill Engine. Charles R. King. Illustrated description of the engine recently built for operating the blooming and girder mills at Seraing in place of the small units hitherto employed. 1200 w. Mach, N. Y.—Jan, 1906. No. 74113 C.

We supply copies of these articles. See page 957.

Engine Tests.

Report of the Official Test of the Double Cross-Compound Engines in the Fifty-ninth Street Power Station of the Interborough Rapid Transit Company of New York. Gives a description of the conduct of the test proper and the subsidiary tests, classified as reported by the engineer in charge. 2500 w. St Ry Jour—Jan. 6, 1906. No. 74229 C.

Exhaust Steam.

Exhaust Steam Disposal. Explains the advantages and disadvantages of both high pressure and low pressure engines and why each has its use in practice, and discusses the increase in efficiency by condensing. Ills. 1800 w. Engr, U S A—Jan. 1, 1906. Special No. No. 74322 D.

Feed Water.

Feed-water Heating. An illustrated article considering the classes and types of feed-water heaters, the saving effected, and matters of related interest. 4200 w. Engr, U S A—Jan. 1, 1906. Special No. No. 74323 D.

Water Softening for Boiler Use. T. W. Snow. A short paper and discussion on the need of removing scale forming substance from the water before it is fed to the boilers. Ills. 3300 w. Jour W Soc of Engrs—Dec, 1905. No. 74555 D.

Flue-Gases.

A Portable Apparatus for the Analysis of Flue-Gases. Charles Joseph Wilson. Illustrates and describes an apparatus employed in all the trials carried out by the recent Admiralty committee on Naval Boilers, with good results. 1700 w. Inst of Civ Engrs. (No. 3580.) No. 74355 N.

Forced Draft.

Forced Draft for Boilers. L. J. Wing. Advocates the use of forced draft, and calls attention to some fan applications. 1000 w. Am Soc of Heat & Vent Engrs—Jan, 1906. No. 74338 C.

Furnace Flues.

Tests on the Elasticity of Furnace Flues with Single Corrugations. (Versuche über die Elastizität von Flammrohen mit einzelnen Wellen). C. Bach. Data and results of tests on the Pommée type of flue, containing two deep corrugations in a length of about a metre. 1200 w. Zeitschr d Ver Deutscher Ing—Dec. 23, 1905. No. 74603 D.

Governors.

An Automatic Multi-Stage Turbine Governor. Henry F. Schmidt. Explains the three general ways of accomplishing the variation of steam supply in accordance with the load, and gives an illustrated description of a new type of governor and its operation. 1400 w. Power—Jan., 1906. No. 74131 C.

Governor Springs. H. R. Hall. Gives a chart for determining the dimensions of a spring for a governor, with information in regard to its use, and illustrated by examples. 1800 w. Prac Engr—Dec. 29, 1905. No. 74283 A.

Oil-Burning.

A Simple Oil-Burning Equipment. Courtenay DeKalb. Illustrated description of the equipment installed at the Exposed Treasure mill, Mojave, Calif. 600 w. Eng & Min Jour—Jan. 13, 1906. No. 74380.

Piping.

Piping Plans for the Onondaga County Court-House, Syracuse, New York. Charles L. Hubbard. Illustrates and describes the high-pressure and exhaust piping of the power and heating plant in the new court-house. Some of the features are of exceptional interest. 2200 w. Power—Jan., 1906. No. 74125 C.

Pistons.

Steam Engines with Heated Pistons. (Dampfmascninen mit geheiztem Kolben). Julius Divis. Describing practical attempts to reduce cylinder condensation by introducing live steam into the interior of the piston of a steam engine. 2000 w. Oesterr Zeitschr f Berg u Hüttenwesen—Jan. 13, 1906. No. 74652 D.

Steam Flow.

See Mechanical Engineering, Measurement.

Steam Production.

Distribution of Steam Production in a Locomotive Boiler. Translated from *La Revue Generale*. Gives calculations showing approximately the part played in the total steam production by the direct heating surface of the firebox, and by the tubes. 3800 w. Ry Age—Jan. 12, 1906. No. 74344.

Stoker.

The Shontz Stoker. Illustrates this stoker as applied to stationary boilers. It consists of a hopper into which the coal is fed; a small wheel forces the coal down on to a chain which carries it into the fire box. 900 w. Ry Mas Mach—Jan., 1906. No. 74112.

Turbines.

Interesting Test of a Curtis Steam Turbine. Reports an economy test of a 500 kw Curtis steam turbine installed in the Oshkosh, Wis., Gas Light Co.'s plant. 2000 w. Power—Jan., 1906. No. 74129 C.

Note on Steam-Turbines. Capt. H. Riall Sankey. Gives diagrams illustrating the production of motion energy in steam-turbines of various types, and the conversion of this energy into mechanical work, with explanatory notes. 1400 w. Engng—Jan. 5, 1906. No. 74415 A.

Steam Turbines with Velocity and Pressure Stages (Dampfturbinen mit Geschwindigkeitsstufen und mit Druckstufen). Fritz Krull. Comparing the efficiency of multiple stage steam turbines with velocity drop and those with pressure drop in the successive stages, as discussed by Prof. Rateau at Liége. 2000 w. Zeitschr d Oesterr Ing u Arch Ver—Dec. 29, 1905. No. 74621 D.

Tests of DeLaval Steam-Turbine. Thomas B. Morley. A report of an investigation carried out under the auspices of the Carnegie Trust. Explains the object, describing the apparatus and method of conducting trials, giving results. Ills. 2700 w. Engng—Dec. 29, 1905. No. 74298 A.

The Steam Turbine. Henry Y. Haden. Gives a short history of the turbine, and a description of the most prominent types in the service in America, with remarks on durabilities and economies. 2500 w. Jour of Elec—Jan., 1906. No. 74308 C.

Turbine Machinery. S. A. Everett. Abstract of a paper read before the S. Wales Inst. of Engrs. Briefly reviews the history of the turbine and describes the DeLaval turbine in the present number. Ills. 2300 w. Min Jour—Dec. 23, 1905. Serial. 1st part. No. 74147 A.

See Electrical Engineering, Generating Stations.

MISCELLANY.

Aeronautics.

The Aero Club of America's Exhibit of Aeronautical Apparatus. Illustrates and describes some of the interesting exhibits recently shown in connection with the Sixth Annual Automobile Show, in New York City. 1400 w. Sci Am—Jan. 27, 1906. No. 74572.

The Stability of Aeroplanes and the Rational Construction of Sustaining Planes (Sur la Stabilité des Aéroplanes et la Construction Rationelle des Plans Sustenbateurs). Edmond Seux. An examination of the problem of longitudinal stability, with especial reference to the early work of Penaud. 1500 w. Comptes Rendus—Jan. 8, 1906. No. 74640 D.

The "White Flyer"—The Motor Driven Aeroplane of the Brothers Wright. States what the Wright Brothers have accomplished, the means by which they have effected it, etc. Ills. 3000 w. Auto Jour—Jan. 6, 1906. No. 74395 A.

Congress.

The International Congress of Applied Mechanics at Liége (Congrès Internationale de Mécanique Appliquée, Tenu à Liége). Aime Witz. A general review of the discussions at the Mechanical congress at the Liége exposition. Two articles, 6000 w. Génie Civil—Dec. 16, 23, 1905. No. 74623 each D.

Mechanical Plant.

The Mechanical Plant of the Hotel Belmont, New York City. Briefly outlines the interesting features of this structure on the corner of 42nd St. and Park Ave. and describes the extensive plant that has been installed. Ills. 4800 w. Eng Rec—Dec. 30, 1905. Serial. 1st part. No. 74-137.

Review.

Mechanical Engineering. An editorial review of the year 1905, considering railways; marine, stationary and gas engines; suction gas producers; gas turbines, motor cars, and machine tools. 5000 w. Engr., Lond—Jan. 5, 1906. No. 74426 A.

MINING AND METALLURGY

COAL AND COKE.

Anthracite.

Colorado Anthracite. Prof. Arthur Lakes. An illustrated article describing the fields of the state and the influence of eruptive rocks in metamorphosing the bituminous deposits. 2000 w. Mines & Min—Jan, 1906. No. 74249 C.

Breaker.

A Concrete Breaker. Illustrated description of the application of reinforced concrete construction in building the Pine Hill breaker, near Minersville, Pa. 2500 w. Mines & Min—Jan., 1906. No. 74241 C.

Coal Cutter.

A New English Coal Cutter. James Tonge. An illustrated description of the "Little Hardy" undercutting and shearing machine, the method of setting and operating. 1800 w. Mines & Min—Jan., 1906. No. 74246 C.

Coal Trade.

See Industrial Economy.

Coke.

Coke Making in the United States. Edward W. Parker. Reports recent developments in various coking districts to meet present and future requirements. 3500 w. Ir Age—Jan. 4, 1906. No. 74215.

We supply copies of these articles. See page 957.

Fuel Economy.

Fuel Economy at Bituminous Coal Mines in Pennsylvania. C. E. Watts. Reviews briefly the application of machinery to mining, showing that the equipment is not always economical, and pointing out causes of waste of energy. Describes the remedy applied at the Eureka mines, at Windber, Pa. Discussion. 5000 w. Pro Engrs' Soc of W Penn—Jan., 1906. No. 74540 D.

Fuel Value.

Some Experiments on the Fuel Value of Bituminous Coal Ashes. Henry Fay and F. W. Snow. An account of experiments made to determine the exact amount of unburned coal being thrown away in ordinary soft coal ashes. The expense of recovery would exceed the profit. 1500 w. Tech Qr—Dec., 1905. No. 74586 E.

Illinois.

The Coals of Illinois. S. W. Parr. Reports an increase in the coal output and gives information concerning the deposits, their character, etc. 1500 w. Eng & Min Jour—Jan. 13, 1906. No. 74384.

Indiana.

Indiana Coals. R. P. King. Read before the Indiana Engng Soc. Reviews the growth of the coal industry, the state ranking among the first six of the coal producing states. Gives information concerning the quality, heating value, etc. 3000 w. Eng Rec—Jan. 27, 1906. No. 74772.

Indian Territory.

Asphaltic Coals in the Indian Territory. W. R. Crane. Describes the deposits and the methods of prospecting and mining. Ills. 4200 w. Mines & Min—Jan., 1906. No. 74245 C.

Natal.

Coal in Natal. A report of the coal industry, which is of importance, and information concerning the quality of the coals. 1800 w. Engng—Jan. 5, 1906. No. 74421 A.

Report.

Coal. Reports of the production and trade, from all parts of the United States, by Frederick Hobart, E. Morrison, George H. Cushing, S. F. Luty, L. W. Friedman, J. E. Sheridan, and William Nelson Page. 15000 w. Eng & Min Jour—Jan. 6, 1906. No. 74272.

Separator.

A Revolving Spiral Separator. Illustrated description of a new apparatus being installed for removing slate from anthracite coal at the Truesdale breaker of the D., L. & W. Co. 1200 w. Mines & Min—Jan., 1906. No. 74250 C.

Shipping.

A New Anti-Breakage Coal Shipper. Illustrated description of an appliance invented by James Rigg, aiming to avoid breakage in the trainshipping of coal. 1000 w. Col Guard—Jan. 12, 1906. No. 74521 A.

Transformation.

Hypothesis to Account for the Transformation of Vegetable Matter into the Different Grades of Coal. Marius R. Campbell. Gives a working hypothesis embodying the provisional conclusions of the writer, in explanation of the various grades found in different localities. Heat is considered the principal cause, affected by conditions. 3000 w. Ec Geol—Oct., 1905. No. 74590 D.

COPPER.

Coeur d'Alenes.

The Copper Deposits of the Coeur d'Alenes. A description of this mining district in Idaho with outline map showing copper belt, and an account of development. 3500 w. Min Wld—Jan. 20, 1906. No. 74490.

Copper Trade.

See Industrial Economy.

Electric Refining.

See Electrical Engineerng, Electrochemistry.

Enrichment.

Secondary Enrichment in Ore-Deposits of Copper. James Furman Kemp. Reviews the chief copper ores, with comments upon them, aiming to stimulate close study of their succession in formation. 5000 w. Ec Geol—Oct., 1905. No. 74589 D.

Siberia.

The Spassky Copper Mine, Ltd. Edward Walker. Gives details of the location and history of this mine in Siberia, describing the latest developments. 1200 w. Map & plan. Eng & Min Jour—Dec. 30, 1905. No. 74107.

GOLD AND SILVER.

Assay Values.

Tables for Calculating Assay Values for Gold and Silver in Ores. etc. George T. Holloway. Gives the tables used by the author for some years in calculating assay values, with explanatory notes. 3000 w. Min Jour—Jan. 13, 1906. No. 74520 A.

Australia.

Occurrence of Albite in the Bendigo Veins. Waldemar Lindgren. Information concerning the discovery of albite with quartz from the gold-bearing veins of Bendigo, tending to confirm the relationship of these deposits to the gold-quartz deposits of California. 200 w. Ec Geol. Nov., 1905. No. 74700 D.

We supply copies of these articles. See page 957.

The Indicators of Ballarat. Prof. J. W. Gregory. Describes briefly this interesting goldfield, explaining the indicator line and giving an account of its discovery. Ills. 2200 w. Min Jour—Jan. 20, 1906. No. 74743 A.

The South Kalgurli Company's System of Ore Treatment. Arthur C. Claudet. Gives a diagram and description of the ore treatment at the new plant which handles 230 short tons per day. 1200 w. Eng & Min Jour—Jan. 20, 1906. No. 74472.

California.

The Mojave Mining District of California. Charles E. W. Bateson. An illustrated description of the location, climate and vegetation, topography, rocks and their origin, veins and their formation. 4800 w. Am Inst of Min Engrs—Jan, 1906. No. 74715 C.

Colorado.

The Gold Deposits of Plomo, San Luis Park, Colorado. Charles Godfrey Gunther. Gives a general illustrated description of the district, its geology, ore bodies, etc. 3000 w. Ec Geol—Nov, 1905. No. 74598 D.

Cripple Creek.

The Metallurgy of Cripple Creek, Colorado, Ores. Godfrey D. Doveton. Gives short accounts of the treatment of the various classes of ore. 5400 w. Min Jour—Dec. 23, 1905. No. 74148 A.

Cyanide.

Cyanidation During 1905. Charles H. Fulton. A review of the progress during the year, especially the treatment of slimes, the application to silver ores, and the successful treatment of cupriferous gold and silver ores. 4500 w. Eng & Min Jour—Jan. 13, 1906. No. 74381.

Notes on the Cyanide Process. R. Stuart Browne. An explanation of this process, considering the crushing of the ore, dissolving the gold and silver, precipitation, refining, etc. 5000 w. Min Wld—Dec. 30, 1905. No. 74118.

The Cyanide Process at Guanajuato. Francis J. Hobson. An account of tests made to determine the best method of extraction for these gold and silver ores. 1500 w. Min & Sci Pr—Jan. 6, 1906. No. 74367.

The Importance of Fine-Grinding in the Cyanide-Treatment of Gold- and Silver-Ores. Frederick C. Brown. Calls attention to the importance of fine-grinding in the treatment of comparatively low-grade ores, giving information and results of experiments. 2200 w. Am Inst of Min Engrs—Jan., 1906. No. 74712.

Distillation.

The Distillation of Gold (Sur la Distillation de l'Or). Henri Moissan. A description of the successful experiments of the author in the volatilisation and distillation of gold and gold alloys in the electric furnace. 2500 w. Comptes Rendus—Dec. 11, 1905. No. 74637 D.

Dredging.

Gold Dredging in 1905. J. P. Hutchins. A review of the progress in this business, the failures and the causes, practice and dredge design, sampling, etc. 3000 w. Eng & Min Jour—Jan. 20, 1906. No. 74471.

Enrichment.

Secondary Enrichment. Sydney Fry. An account of researches at the Britannia gold mine in New Zealand. 1600 w. Aust Min Stand—Dec. 20, 1905. No. 74466 B.

Goldfield, Nev.

Deeper Workings of the Goldfield, Nev., Mines. A. G. Hillen. Gives details of the more important properties of this district, showing the richness of the mineral veins in nearly all the deeper workings. 3800 w. Min Wld—Jan. 13, 1906. No. 74373.

Japan.

Gold Mining in Japan. A. R. Weigall. Read before the Inst, of Min. & Met. (Abstract). Gives historical, geographical, and geological information, describing the deposits, mining methods, and ore treatment. 3000 w. Min Jour—Dec. 30, 1905. Serial. 1st part. No. 74293 A.

Mexico.

The Sahuayacan Mining District, Mexico. John C. Treadwell. Gives the location and geology of this district, with information concerning the mines, deposits, etc. Silver, gold, lead, copper, bismuth, antimony, iron and manganese are found, but the principal values are in gold. Ills. 3000 w. Eng. & Min Jour—Dec. 30, 1905. No. 74109.

Nevada.

South Central Mining Districts of Nevada. A. G. Hillen. A review of the more active operations of the Bullfrog district. 3500 w. Min Wld—Dec. 30, 1905. No. 74117.

New Zealand.

New Zealand's Premier Gold Mine. An account of the Waihi mine and its wonderful progress during the past sixteen years. Ill. 2500 w. N Z Mines Rec—Nov. 16, 1905. No. 74124 B.

Ore Treatment.

The South Kalgurli Company's Ore Treatment Plant. Arthur C. Claudet. Describes this new plant which treats 230 short tons per day by dry crushing, roasting, grinding and amalgamating, agitating with cyanide and filter pressing. 1300 w. Min Jour—Dec. 23, 1905. No. 74146 A.

We supply copies of these articles. See page 957.

Progress in Gold-Ore Treatment. During 1905. Alfred James. A. review of the main features which have been in the direction of finer crushing and the treatment of slimes. 3200 w. Eng & Min Jour—Jan., 1906. No. 74267.

Placers.

Deep Placer Deposits of Victoria. H. L. Wilkinson. Discusses the principles which have affected the value of the regularly defined "deep leads" Maps. 2500 w. Eng & Min Jour—Dec. 30, 1905. No. 74108.

Pockets.

A Big Pocket. John B. Farish. A brief account of the finding of a big nugget in the Monumental mine, California. 1000 w. Min & Sci Pr—Jan. 13, 1906. No. 74492.

Pumping Plant.

Large Pumping Plant at Tasmania Gold Mine. Frank C. Perkins. Illustrated description. 800 w. Mines & Min—Jan., 1906. No. 74251 C.

Reports.

See Industrial Economy.

Silver-Lead.

Coppabella Mining Field. Joseph E. Crane. A report to the New South Wales Mines Department on this silver-lead field. 3000 w. Aust Min Stand—Dec. 6, 1905. Serial. 1st part. No. 74446 B.

South Africa.

The Transvaal. W. Fischer Wilkinson. A report of the mining industry in the Transvaal for 1905, showing increase in production and giving much information. 3700 w. Eng & Min Jour—Jan. 13, 1906. No. 74382.

Temiskaming.

The Cobalt-Nickel Arsenides & Silver Deposits of Temiskaming. Information from a report by Prof. Willet G. Miller, Provincial Geologist of Ontario. Ills. 2300 w. Can Min Rev—Jan., 1906. No. 74498 B.

Utah.

Structural Features of the Ontario Mineral Belt, Park City, Utah. Walter P. Jenney. Describes this region of great interest to the geologist, and valuable mines of silver-lead ores. 2700 w. Min & Sci Pr—Jan. 6, 1906. No. 74366.

Veins.

Are the Quartz-Veins of Silver Peak, Nevada, the Result of Magmatic Segregation? John B. Hastings. Gives description of the quartz occurrences of the Silver Peak mines, discussing their origin. 2700 w. Am Inst of Min Engrs—Jan., 1906. No. 74711.

IRON AND STEEL.

Bessemer.

The Genesis of the Bessemer Process. From Sir Henry Bessmer's recently published autobiography. An account of the writer's researches. Ills. 4500 w. Ir & St Mag—Dec., 1905. No. 74180 D.

Briquetting.

The Briquetting of Iron Ore and Testing of the Blocks (Die Brikettierung der Eisenerze und die Prufung der Erzziegel). Dr. H. Wedding. Discussing the various binding substances for uniting the ore into blocks, and the resistance of the briquettes to breaking down in the furnace. Two articles, 5000 w. Stahl u Eisen—Jan. 1, 1906. No. 74644 each D.

Carbon Determination.

Determination of Carbon in Steel by Direct Ignition with Red Lead. Charles Morris Johnson. Gives the writer's experience with this method, with notes on the reasons for its adoption for routine combustion analysis. Ills. 4000 w. Pro Engr's Soc of W Penn—Jan., 1906. No. 74544 D.

Cementation.

Notes on Cementation Processes (Einiges über das Zementieren). A. Ledebur. A review of the paper of Guillet before the *Société des Ingenieurs Civils de France* in 1904, discussing the operations of case-hardening by cementation. 2000 w. Stahl u Eisen—Jan. 15, 1906. No. 74649 D.

Dry-Air Blast.

The Application of Dry-Air Blast to the Manufacture of Iron. Edward de Mille Campbell. A discussion of the paper by James Gayley. Tables and curves showing the influence of variations in the dew-point are given. 3000 w. Am Inst of Min Engrs—Jan., 1906. No. 74713 C.

Electric Smelting.

See Electrical Engineering, Electrochemistry.

Iron Ores.

Genesis of Lake Superior Iron Ores. Charles Kenneth Leith. A summary of conclusions presented in U. S. Geol. Surv. monographs, with a report of later work and a summary of the general geology of the ores and ore-bearing series. 7500 w. Ec Geol—Oct., 1905. No. 74592 D.

The Hill Iron Ore Properties. Dwight E. Woodbridge. Explains the extent of the Hill holdings, their relations to the Steel Corporation, the advantageous position of the Hill interests and related matters of importance. 3500 w. Ir Age—Jan. 4, 1906. No. 74219.

Iron Trade.

See Industrial Economy.

We supply copies of these articles. See page 957.

Manganese.

Manganese, It's Prices and Uses. Dr. J. Ohly. Gives a copy of the last report issued by the Carnegie Co. in regard to this product, and discusses the changes of importance. 1200 w. Min Wld—Jan. 13, 1906. No. 74372.

Meeting the Insufficient Supply of Manganiferous Ores (Die Deckung des Bedarfs an Manganerzen). Wilhelm Venator. A review of the sources of manganiferous ores in various parts of the world, and the extent to which the demand for steel manufacture can be met. Serial. Part I. 3000 w. Stahl u Eisen—Jan. 15, 1906. No. 74648 D.

Mexico.

Iron Manufacture in Mexico. John Birkinbine. Describes the topography of Mexico and the bearing on iron and steel manufacture, and gives information concerning the industry. The conditions are considered encouraging. 2200 w. Ir & St Mag—Jan., 1906. No. 74535 D.

Pig Iron.

See Industrial Economy.

Plate Mills.

The Central Iron and Steel Company's Plate Mills at Harrisburg, Pa. Reviews the history of these works and gives an illustrated detailed description. 4000 w. Ir Age—Jan. 4, 1906. No. 74222.

Rolling Mills.

See Mechanical Engineering, Machine Works and Foundries.

Spiegeleisen.

An Old Specimen of American Spiegeleisen. Frank Firmstone. Description and analysis of a piece of spiegeleisen, supposed to have been made at the old charcoal furnace which once stood at the village of Andover, N. J. 1000 w. Am Inst of Min Engrs—Jan., 1906. No. 74709.

Steel Plates.

Manufacture of Steel Plates. G. M. Kohler. The present article considers the production of the ingots, the molds, casting, stripping, reheating, &c. Ills. 2200 w. Boiler Maker—Jan., 1906. Serial. 1st part. No. 74161.

MINING.

Accidents.

Safety Measures in Mining. Donald Macaulay and Louis G. Irvine. The present paper discusses measures in cases of ordinary accidents, and measures in cases of gassing. 7000 w. Jour Chem, Met & Min Soc of S Africa—Nov., 1905. No. 74399 E.

Agriculture.

The Relations of Mining and Metallurgy to Agriculture. F. W. Traphagen. Abstract of a paper read before the West. Assn. of Tech., Chem & Met. Discusses cases of damage caused by mills and smelters to crops and farm animals, with special reference to conditions in Montana. 2500 w. Min Jour—Jan. 6, 1906. No. 74409 A.

Alaska.

Present Conditions in Southern Alaskan Mining Districts. Wm. M. Brewer. A fully illustrated review of mining work in Southern Alaska, discussing especially gold and copper production and prospects. 4000 w. Engineering Magazine—Feb., 1906. No. 74673 B.

Australia.

Eastern States of Australia. F. S. Mance. A review of a most satisfactory year, giving statements in regard to gold, silver, copper, tin, coal, and other minerals. 2200 w. Eng & Min Jour—Jan., 1906. No. 74264.

Blasting.

An Improved Form of Electric Exploder for Blasting. J. Schuermann. Gives an illustrated detailed description of the ordinary electric exploder, and also of the improved type explaining its advantage. 1000 w. Eng News—Jan 25, 1906. No. 74563.

Brazil.

The Geology of the Diamond and Carbonado Washings of Bahia, Brazil. Orville A. Derby. Translation of a report to the Governor, and the most important paper thus far published on the geology of this region. 3000 w. Ec Geol—Nov., 1905. No. 74597 D.

British Columbia.

British Columbia. E. Jacobs. A report of the mineral production of the year, the improvements and prospects. 1500 w. Eng & Min Jour—Jan. 6, 1906. No. 74265.

California.

The Mining Industries of California. Charles G. Yale. A brief review of the mining industries of the State during the year of 1905. 2500 w. Eng & Min Jour—Jan. 6, 1906. No. 74257.

Colorado.

Metal Mining in Colorado During 1905. George E. Collins. A report of the year 1905, giving details of the various districts. 2300 w. Eng & Min Jour—Jan. 6, 1906. No. 74262.

Concentrator.

A Lead and Zinc Concentrator at Roseberry, B. C. Alfred W. Dyer. Brief illustrated description. 1500 w. Can Min Rev—Jan., 1906. No. 74497 B.

Crushing.

The Effect of Variation in the Speed of Crushing Machinery Upon the Production of Undersized Material. H. W. Gar-

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trell. An investigation of this subject showing that while decrease of speed tends to decrease the production of undersized material, it does so in a degree so small that it is disproportionate to the disadvantage of decreased capacity. 1200 w. Sch of Mines Qr—Nov., 1905. No. 74546 D.

Death Valley.

Explorations in Death Valley District. Col. E. F. Browne. Describes the geology and general appearance of this district and the conditions to be met. Information concerning the deposits and dangers to be encountered. 3300 w. Min Wld—Jan. 20, 1906. No. 74488.

Deep Drilling.

Modern Deep Drilling Practice in Europe. Will Halder. Sketches the development of modern methods of deep drilling, with special reference to those which depend upon a succession of quick blows with decreased height of fall. 2000 w. Min Mag—Jan., 1906. No. 74349 C.

Divining Rods.

Unscientific and Scientific Divining Rods. George M. Hopkins. An illustrated article describing principally the scientific devices used in locating metal ores. 1800 w. Sci Am Sup—Jan. 20, 1906. No. 74443.

Door Opener.

A Hydraulic-Pneumatic Mine Door Opener. L. L. Logan. Illustrated description of a safety derailing latch for operating any door against any pressure. 3000 w. Mines & Min—Jan., 1906. No. 74242 C.

Electric Plants.

Electrical Installation at the Hasard Colliery, Belgium. M. R. A. Henry. Abstract of a paper before the Min. Cong. at Liége. Illustrated description. 900 w. Col Guard—Dec. 29, 1905. No. 74295 A.

Some Electric Installations in European Mines. Emile Guarini. Illustrates and describes different kinds of apparatus for chain and locomotive haulage, hoisting and ventilating. 2500 w. Mines & Min—Jan., 1906. No. 74243 C.

Explosives.

The Nature of Nitro Explosives (Ueber das Wesen der Nitro-Sprengstoffe). O. Stegemann. Discussing especially the chemistry and action of the nitro-glycerin explosives used in mining operations. 3000 w. Glückauf—Dec. 30, 1905. No. 74654 D.

Fire Damp.

Mine Temperatures and the Influence of Natural Weather Conditions Upon the Production of Firedamp (Ueber Grubenlufttemperaturen und den Einfluss des Naturlichen Wetterzuges auf die Wetterwirtschaft bei Einigen Tiefen Schächtendes Brüxer Braun Kohlen reviers). L. Stadlmayr. Data showing the relation of the release of mine gases to external weather conditions. Serial. Part I. Oesterr Zeitschr f Berg u Hüttenwesen—Jan. 6, 1906. No. 74651 D.

Tests of Devices to Protect Electric Apparatus from Firedamp (Versuche zwecks Erprobung der Schlagwettersicherheit besonders Geschützter Elektrischer Motoren und Apparate). H. Beyling. An illustrated account of tests in the experimental tunnel at Gelsenkirchen upon the ignition of firedamp from electrical apparatus. Serial. Part I. 3000 w. Glückauf—Jan. 6, 1906. No. 74655 D.

The Beard-Mackie Light-Indicator for the Measurement of Marsh-Gas in Collieries. M. H. Harrington. An illustrated description of this indicator, which has been successfully tested in practice. 2800 w. Am Inst of Min Engrs—Jan., 1906. No. 74714.

Fires.

Controlling and Extinguishing Fires in Pyritous Mines. Lewis T. Wright. Explains the causes of such fires, and the system adopted by the writer for extinguishing and controlling them. 1800 w. Eng & Min Jour—Jan. 27, 1906. No. 74727.

Fissures.

The Fissure System of the Ontario Mineral Belt. W. P. Jenney. Description, with diagrams, of the mineral bearing veins and the verticals. 2200 w. Min & Sci Pr—Jan. 13, 1906. No. 74493.

Idaho.

Mining in Idaho in 1905. Robert N. Bell. A review of the mining developments for the vear, not including the Couer d' Alene district, which is reported separately. 2300 w. Eng & Min Jour—Jan. 6, 1906. No. 74258.

Japan.

The Mining Industry in Japan. W. J. Johnston. Statistical data concerning the growth of the mining industry in Japan, and notes on the present status of the industry. 4000 w. Min Mag—Jan., 1906. No. 74348 C.

Joplin.

Structural Features of the Joplin District. C. E. Siebenthal. Reviews the work that has been done in studying this district, and states the conclusions reached. Also discussion by H. Foster Bain. 4400 w. Ec Geol—Nov., 1905. No. 74595 D.

Klondike.

The Klondike in 1905. J. P. Hutchins. Discusses the causes of the lessened production, the mining methods, water supply, mining laws and regulations. 2500 w.

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Eng & Min Jour—Jan. 6, 1906. No. 74256.

Mexico.

Fine Grinding Ore by Tube-Mills, and Cyaniding at El Oro, Mexico. G. Caetani and E. Burt. Gives the results of a series of experiments and tests made in view of determining the economical limit to which the fine grinding of ore by tube-mills could be carried. 15800 w. Am Inst of Min Engrs—Jan., 1906. No. 74716 D.

Mexico. James W. Malcolmson. A report of the mineral industry and its progress during the past year. 2000 w. Eng & Min Jour—Jan. 6, 1906. No. 74266.

Mining Hints.

Economic Mining Hints. P. A. Leonard. Emphasizes the importance of good management, and a study of local conditions, the cost of transportation and reduction. 1700 w. Min Wld—Jan. 20, 1906. No. 74487.

Mining Law.

The American Law Relating to Minerals. Charles H. Shamel. An exposition of that part of American mining law that deals with the definitions and the legal conception of the terms mineral, ore, &c., as used in law. 10800 w. Sch of Mines Qr—Nov., 1905. No. 74545 D.

The Present Mining Law of Pennsylvania. Thomas K. Adams. Read before the W. Penn. Cent. Min. Inst. Discusses whether it should be revised, and how, suggesting some changes. 2800 w. Mines & Min—Jan., 1906. No. 74247 C.

Mining Problems.

The Graphical Solution of Mining Problems. Leo Gluck. Illustrates and describes an apparatus designed by the writer for the solution of many problems without requiring the use of mathematical formulæ. 1800 w. Min Wld—Jan. 13, 1906. No. 74371.

Montana.

Montana in 1905. A. Selwyn-Brown. A report of the year, giving information in regard to the output of copper, silver, gold, zinc, coal, and sapphires. 1800 w. Eng & Min Jour—Jan. 6, 1906. No. 74263.

Nevada.

Nevada in 1905. A. Selwyn-Brown. An interesting review of a prosperous year, with illustrations of Tonopah. 2000 w. Eng & Min Jour—Jan. 6, 1906. No. 74261.

New Zealand.

Mining and Metallurgical Methods of the Waihi Gold Mining Company, New Zealand. F. N. Rhodes. Illustrated detailed description of the processes adopted at the works of the Waihi Gold Mining Company for the mining and treatment of gold ores. 2800 w. Min Mag—Jan., 1906. No. 74347 C.

Ore Deposits.

Ore Deposition and Deep Mining. Waldemar Lindgren. A review of what has been accomplished in determining the mode of disposition of ores, and the probabilities of finding workable ores in depths. 5000 w. Ec Geol—Oct., 1905. No. 74591 D.

The Chemistry of Ore-Deposition—Precipitation of Copper by Natural Silicates. Eugene C. Sullivan. A report of experimental work. 2000 w. Ec Geol—Oct., 1905. No. 74593 D.

The Phase Rule and Conceptions of Igneous Magmas—Their Bearing on Ore Deposition. Thomas Thornton Read. Presents some considerations relating to rock magmas, and the laws which govern them, in relation to their bearing on the formation of ores. 6000 w. Ec Geol—Nov., 1905. No. 74594 D.

Ore Loading.

Electrically Operated Ore Loading Plants and Wire Rope Tramways. Frank C. Perkins. Illustrates and describes some improved methods employed for ore loading, and the power utilized. 2000 w. Min & Sci Pr—Dec. 23, 1905. No. 74119.

Respirator.

Respiratory Apparatus for the Exploration of Localities Filled with Irrespirable Gases (Appareil Respiratoire pour l'Exploration des Milieux Remplis de Gaz Irrespirable). M. Guglielminetti. A portable device, using caustic potash to absorb the carbonic acid from the expired air, the oxygen being supplied from a separate reservoir. 1200 w. Comptes Rendus —Jan. 2, 1906. No. 74639 D.

Rhodesia.

Mining and Mineral Industry in Rhodesia. E. H. Garthwaite. An account of this interesting portion of S. Africa, its deposits of gold, copper, lead and zinc ores, the mines and mining laws, cost of supplies. 5200 w. Min Mag—Jan., 1906. No. 74345 C.

Shafts.

Shaft Sinking in Quicksand. George C. McFarlane. Illustrates and describes a shaft in Michigan as a fine example of the successful application of a steel shoe in sinking a rectangular shaft through a heavy bed of quicksand. 1200 w. Eng & Min Jour—Jan. 20, 1906. No. 74474.

Shaft Sinking Through Sand. T. H. Mottram. Abstract of a paper before the Mining Inst. of Scotland, describing the sinking of shafts through sand at Ardeer, Ayrshire, by the pneumatic process. 2800 w. Col Guard—Dec. 29, 1905. No. 74294 A.

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Sinking by the Up-Over Method. William Belfitt. Explains the conditions and describes the method adopted. Ills. 1200 w. Ir & Coal Trds Rev—Dec. 22, 1905. No. 74160 A.

Steam Pipes in Shafts. R. D. O. Johnson. Illustrates and describes an arrangement used by the writer which overcame the usual difficulties and proved satisfactory. 1000 w. Eng & Min Jour—Jan. 27, 1906. No. 74728.

Slipping Planes.

Slipping Planes in Mines. Arthur Lakes. Illustrates and describes peculiarities due to folding or faulting. 800 w. Min Rept—Jan. 4, 1906. No. 74237.

Smelting.

A Combined Siphon-Spout and Matte-Trap. Henry Harris. Illustrated description of this design which has been used continuously for some months with pleasing results. 1000 w. Eng & Min Jour—Jan. 27, 1906. No. 74731.

Tracks.

Track Construction in Mines. Leo Gluck. Abstract of a paper read before the Illinois Soc. of Engrs. & Survs. Briefly considers the switches, gauge of tracks, frog angles, &c. 600 w. Eng News—Jan. 25, 1906. No. 74569.

Tunnels.

A Colorado Mining Tunnel. Thomas Tonge. The conditions in Colorado are described, and the three tunnels now being driven are outlined, especially describing the Central Tunnel. 3000 w. Min Jour—Jan. 6, 1906. No. 74410 A.

Big Cross-Cut Tunnels of Clear Creek County, Colo. H. C. Newton. Extracts from a recent article by Gen. Frank Hall, describing briefly the Newhouse, Burns-Moore, Honest John, "Big 40," Central and Lucania, Gold Valley, Commodore, and Alvarado tunnels. 3000 w. Min Wld—Jan. 20, 1906. No. 74491.

The Lucania Tunnel. An illustrated account of this tunnel for the development of Colorado mines. 3000 w. Min Ind—Jan. 15, 1906. No. 74448.

The Newhouse Tunnel. An interesting illustrated account of this enterprise in Colorado, describing the property and the territory tributary to it. 2500 w. Min Ind—Jan. 15, 1906. No. 74447.

Turkey.

Mining in Turkey. B. Nogara. An illustrated description of the conditions of mining in the Turkish Empire. 1400 w. Min Mag—Jan., 1906. No. 74346 C.

Utah.

Mining Progress in Utah in 1905. L. H. Beason. A review of the year, showing increase in output in gold, silver and copper, especially the latter. 4000 w. Eng & Min Jour—Jan. 6, 1906. No. 74259.

Veins.

Ore-Horizons in the Veins of the San Juan Mountains, Colorado. Chester Wells Purington. Considers an occurrence in southwest Colorado, where nearly vertical metalliferous veins traverse horizontally bedded lavas and underlying sediments. 1800 w. Ec Geol—Nov., 1905. No. 74596 D.

The Problem of the Metalliferous Veins. James Furman Kemp. Presidential address to the N. Y. Academy of Sciences. An interesting discussion of metalliferous deposits, their origin, and matters of related interest. 8500 w. Ec Geol—Dec., 1905. No. 74705 D.

Virginia.

Mining of Zinc, Lead, Iron, and Coal in Virginia. Thomas L. Watson. A review of the mineral industry in the State, the production, new developments, &c. 4800 w. Eng & Min Jour—Jan. 6, 1906. No. 74260.

Winding.

A Controlling Device. Illustrated description of Nicholson's controlling device for automatically stopping a steam hoisting engine when the cage passes a given point. 1400 w. Mines & Min—Jan., 1906. No. 74248 C.

Electric Winding Considered Practically and Commercially. W. C. Mountain. Abstracts of a paper read before the Manchester Soc. of the Inst. of Elec. Engrs. A tabulated statement of the actual cost of winding by steam engines at large collieries is given, and relative estimates of the cost of winding by steam and electricity. 4000 w. Ir & Coal Trds Rev—Jan. 19, 1906. No. 74759 A.

Wisconsin.

Structural Relations of the Wisconsin Zinc and Lead Deposits. Ulysses Sherman Grant. Presents results due to detailed mapping of selected areas of this field. Describes the geology, the ore-deposits, and discusses their origin. 2200 w. Ec Geol—Dec., 1905. No. 74706 D.

Working Costs.

The Distribution of Power on Mines. C. E. Hutton. Describes the method of power account apportionment adopted at the Van Ryn mines. Tables and discussion. 7500 w. Jour S African Assn of Engrs—Nov., 1905. No. 74393 F.

MISCELLANY.

Borax.

The Borax Deposits of California. G. E. Bailey. Illustrates and describes these deposits and their development. 1200 w. Min Wld—Jan. 6, 1906. No. 74231.

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Fluorspar.

Fluorspar. E. Julius Fohs. A review of the production during 1905, giving information of the different districts, methods of mining, uses, &c. 2300 w. Eng & Min Jour—Jan. 6, 1906. No. 74269.

Lead and Tin.

Lead and Tin in 1905. E. A. Caswell. A review of the markets and the causes affecting them. 2800 w. Ir Age—Jan. 4, 1906. No. 74217.

Metallurgy.

Experiments on the Metallurgical Behavior of a Mixture of Lead Sulphide and Calcium Sulphate. F. O. Doeltz. Reports the experiments and gives the conclusion reached. 1600 w. Eng & Min Jour—Jan. 27, 1906. No. 74729.

Petroleum.

Oil and Gas Development in the Mid-Continental Field in 1905. Erasmus Haworth. Reports concerning the Kansas-Indian Territory field, the development, refineries, pipe lines, &c. 6000 w. Eng & Min Jour—Jan. 13, 1906. No. 74383.

Oil Conditions in California. A statement of present conditions in the different fields. 1800 w. Am Gas Lgt Jour—Jan. 22, 1906. No. 74482.

Quicksilver.

California Quicksilver. Charles G. Yale. Reports affairs in this industry to be in a rather bad state, discusssing some of the causes. 1500 w. Eng & Min Jour—Jan. 6, 1906. No. 74270.

The Quicksilver Deposits of Brewster County, Texas. William Battle Philips. Gives an illustrated general description and detailed description of the Terlingua district and the Study Butte district. 2600 w. Ec Geol—Nov., 1905. No. 74599 D.

The Terlingua Quicksilver Deposits. H. W. Turner. Describes the general geology of the district, the deposits in the tertiary lavas, and in sedimentary rocks, and the minerals of the quicksilver lodes. Ills. 5000 w. Ec Geol—Dec., 1905. No. 74708 D.

Vanadium.

Utilizing Vanadiferous Sandstone. Dr. J. Ohly. Outlines a commercial process that might serve for the production of sodium uranate and ammonium vanadate. 2000 w. Mines & Min—Jan., 1906. No. 74244 C.

Zinc.

The Wisconsin Zinc Field. E. Hedburg. Gives the history of this region, describing the deposits and some of the mines, and the ore treatment. 3000 w. Min Wld—Jan. 20, 1906 No. 74489.

Zinc Industry, Broken Hill. Edward Laughton. Discusses the profits derivable and the different processes for recovering zinc from the tailings. 1800 w. Aust Min Stand—Dec. 6, 1905. No. 74445 B.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Accidents.

How to Avoid Accidents. From a paper prepared by the Claim Department of the A., B. & C. Railroad calling attention to some of the causes of accidents and means of preventing them. 4000 w. R R Gaz—Vol. XL, No. 1. No. 74211.

Fast Trains.

The Fastest Trains in Europe and America. Arnold Kramer, in *Annalen für Gewerbe und Bauwesen.* Information concerning the fastest regular trains at the present time. 900 w. Bul Int Ry Cong—Dec., 1905. No. 74562 E.

MOTIVE POWER AND EQUIPMENT.

Brakes.

Sauvage Safety Brake. Describes this system and explains its object, reporting tests. 3500 w. Ry & Engng Rev—Jan. 20, 1906. No. 74486.

Cars.

Car Construction and Cost Records: Chicago, Milwaukee & St. Paul Railway. Describes the system of records adopted by this road and special features of the construction and repair work. 2800 w. Eng News—Jan. 25, 1906. No. 74565.

Design of Steel Cars with Reference to Repairs. A Stucki. A discussion of points that should be carefully watched in order to facilitate the repair of steel cars. 1500 w. Am Engr & R R Jour—Jan., 1906. No. 74102 C.

Steel Railway Coaches. Brief illustrated description of steel coaches for the Great Northern and City Railway. 900 w. Engr, Lond—Dec. 22, 1905. No. 74159 A.

Controversy.

Controversy Over Continuous Current and Single-Phase Systems. A review of the discussion caused by the proposed installation of the single-phase alternating current system in the electrification of the N. Y., N. H. & H. R. R. entering New

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York City. 4800 w. Ry & Engng Rev—Jan. 13, 1906. No. 74376.

Cylinders.

Locomotive Cylinders. Hal. R. Stafford. Considers some of the problems in modern practice, and gives suggestions for solving them. Ills. 3000 w. Am Engr & R R Jour—Jan., 1906. No. 74100 C.

Dynamometer Car.

Note on the Dynamometer Car of the Belgian State Railway. A. Huberti and J. Doyen. Illustrated description of the car and appliances and the working. 9600 w. Bul Int Ry Cong—Dec., 1905. No. 74561 E.

Electrification.

A Note on the Electrification of Trunk Line Railways. H. Ward Leonard. Points out the advantage of electricity for freight haulage, because of the possibility of making up larger train units at a lower cost per ton mile. 1600 w. St Ry Jour—Jan. 27, 1906. No. 74725 C.

Electrification of the New York Central Terminal in and near New York City. An illustrated detailed description of the important changes, considering the organization, line, power, track, terminals and stations. Six insets. 8400 w. Ry Age—Jan. 26, 1906. No. 74721.

Electrification of the Paris-Orleans Suburban Line. Illustrates and describes the electrification of the Paris-Juvisy section. The traction is effected by electric locomotives or rail motorcars, which take continuous current at 600 volts from an outside third rail. 1600 w. Engng—Jan. 5, 1906. No. 74417 A.

The Electrical Equipment for the New York Central. Interesting letters on this subject from Mr. George Westinghouse and B. G. Lamme. 600 w. Elec Wld & Engr—Dec. 30, 1905. No. 74163.

Hospital Cars.

A Hospital Car for the Southern Pacific Ry. Illustrates and describes an unusually large and well-equipped hospital car. Also refers to this class of cars in use on other roads. 2000 w. Eng News Jan. 11, 1906. No. 74332.

Injectors.

Locomotive Injectors, Modern Practice. Strickland L. Kneass. Abstract of a paper read before the Traveling Engrs. Assn. Explains the principle upon which the injector operates, the importance of the location, the systems in use and the desirable features of the ideal modern locomotive injector. 2000 w. Ry Age—Dec. 29, 1905. No. 74099.

Locomotives.

Balanced Compound Locomotives in Service. Sanford H. Fry. Gives illustrations and describes types of these engines, presenting results obtained in actual service. Short discussion. 5500 w. S & S-W Ry Club—Nov. 16, 1905. No. 74764 E.

Contractors' Locomotives. J. F. Gairns, Reviews the conditions governing the design and construction of such engines and their field of usefulness. Ills. 3000 w. Cassier's Mag—Jan., 1906. Serial. 1st part. No. 74465 B.

Development of the Steam Locomotive. Samuel Rendell. Abstract of a paper by one of the Manchester Assn of Engrs. A review showing the growth and alteration in general appearance and comparing with engines of fifty years ago. 4000 w. Mech Engr—Jan. 20, 1906. No. 74735 A.

Experimental Locomotives for the Pennsylvania Railroad. Illustrated descriptions of engines, two of each of five types having been ordered for experimental and observation purposes. 2200 w. R R Gaz—Vol. XL, No. 1. No. 74212.

Express Locomotive for the Malmö-Ystad Railway (Schnellzuglokomotive für die Bahn Malmö-Ystad). A. Doeppner. Illustrating a special locomotive, with snowplow attachment built by Borsig for a Swedish railway. 1000 w. 1 plate. Zeitschr d Ver Deutscher Ing—Jan. 6, 1906. No. 74606.

Four-Cylinder Locomotive for the Eastern Railway of France. H. W. Hanbury. Plate, illustration and description of a compound locomotive exhibited at the Liége Exhibition. 2200 w. Engng—Dec. 22, 1905. No. 74151 A.

Good's Locomotives on Foreign Railways. Charles S. Lake. Illustrated descriptions of types, noting features of special interest. 1500 w. Mech Engr—Dec. 23, 1905. Serial. 1st part. No. 74145 A.

Heavy American Type Locomotive, C. R. R. of N. J. Illustration, with brief description of a new heavy American type of locomotive with Walschaert valve gear. 500 w. Ry & Engng Rev—Jan. 13, 1906. No. 74375.

Heavy Eight-Wheeled Passenger Locomotive for the Central R. R. of New Jersey. Illustrated detailed description of exceedingly heavy engines of the 4-4-0 type, for passenger service over heavy grades and sharp curves. 1000 w. R R Gaz—Vol. XL, No. 3. No. 74453.

Latest Canadian Pacific 4-6-0. Illustration with description of a type of engine intended for passenger and freight service. 500 w. Ry & Loc Engng—Jan., 1906. No. 74200 C.

Mikado Type Freight Locomotives. Illustration and general data of engines built for the Deepwater Ry. Co. 300 w. Am Engr & R R Jour—Jan., 1906. No. 74104 C.

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New Baltimore and Ohio Consolidation Locomotives. J. E. Muhlfeld. A statement of the features considered in the design, construction, operation, and maintenance of the E-27 class, with illustration and general dimensions. 2200 w. Am Engr & R R Jour—Jan., 1906. No. 74105 C.

New Compound Locomotives for the Great Central Railway. Illustrated description of an Atlantic (4-4-2) type three-cylinder compound passenger engine recently completed. 1000 w. Mech Engr—Jan. 20, 1906. No. 74733 A.

New Compound Locomotive on the Great Central Railway. Charles Rous-Marten. Discusses the three-cylinder compound engine just built from a design of J. G. Robinson for the fastest express service. Ills. 2500 w. Engr, Lond—Jan. 19, 1906. No. 74752 A.

Six-Coupled Engines on the Glasgow and South-Western Railway. Charles Rous-Marten. A large woodcut of this new type of engines, with drawings of the tender, and a discussion of the work of the engine. 4000 w. Engr, Lond—Jan. 5, 1906. No. 74423 A.

Six-Coupled Express Engine. Two-page drawing and brief description of bogie engine for heavy and fast service between Glasgow and Carlisle on the Glasgow & South-Western Ry. Particulars of the working will be given in the next issue. 700 w. Engr, Lond—Dec. 29, 1905. No. 74299 A.

Tendencies in Locomotive Building. Editorial on the features of this work during the past year. 1000 w. Ry & Loc Engng—Jan., 1906. No. 74199 C.

Thermal Storage Locomotive. Brief illustrated description of a radial tank locomotive of the 2-4-2 type belonging to the Lancashire and Yorkshire Railway, which has been fitted with the Druitt-Halpin system of thermal storage. 300 w. Mech Engr—Jan. 6, 1906. No. 74402 A.

Railway Automobiles.

Petrol Automotor for Railway Service (Draisine à Pétrole pour Voies Ferrées). An illustrated description of the Campagne car, designed for inspection service and light emergency traction on the French railways in Tunis. 1200 w. Génie Civil—Dec. 23, 1905. No. 74628 D.

Wolseley 140 H. P. Railroad Car Motor. Illustrated description of an engine having six opposed cylinders, now installed in an experimental self-propelled coach at the Schenectady shops of the General Electric Co. 1500 w. Automobile—Jan. 4, 1906. No. 74203.

Regulating Valves.

The Dimensions of the Openings for Locomotive Regulating Valves (Ueber die Grösse der Lokomotive-Regulator Einströmöffnung). A. Langrod. A mathematical examination of the flow of steam through regulating valves in accordance with the modern theory of Gutermuth. 2000 w. Glasers Annalen—Jan. 1, 1906. No. 74615 D.

Testing Plant.

Locomotive Testing Plant at Swindon Drawings and photographs illustrating the plant of the Great Western Railway, England, with description of the mechanism. 2000 w. Engr, Lond—Dec. 22, 1905. No. 74158 A.

Valve Gear.

Walschaert Valve Gear. An explanation of the mechanism, taken from advance sheets of articles prepared by the American Locomotive Co. Gives reasons for its preference. 2500 w. Ry & Engng Rev—Jan. 6, 1906. No. 74236.

Walschaert Valve Gear. Carl J. Mellin. From an Am. Locomotive Co. pamphlet. General description, with methods of adjusting valves and of laying out the Walschaert gear. 2500 w. Am Engr & R R Jour—Jan., 1906. No. 74103 C.

NEW PROJECTS.

Extension.

The Thief River Falls Extension of the "Soo" Line. An account of an important piece of railroad construction during this last year, on the M., St. P. & S. St. M. Ry., through Minnesota and N. Dakota. Map and profiles. 1200 w. R R Gaz—Vol. XL, No. 4. No. 74580.

Philippines.

Philippine Railroad Projects. L. E. Bennett. An illustrated article giving information of work completed and proposed, the conditions, native labor, &c. 4000 w. R R Gaz—Vol. XL, No. 1. No. 74213.

Rhodesia.

The Rhodesia Railways in South Africa. Frank C. Perkins. An illustrated article describing these railways and their rolling stock. 1600 w. Sci Am Sup—Jan. 20, 1906. No. 74442.

PERMANENT WAY AND BUILDINGS.

Bridges.

See Civil Engineering, Bridges.

Culverts.

Notes on the Design and Construction of Reinforced Concrete Culverts. C. F. Graff. Discusses the advantages and economy of this type of culvert and submits designs of reinforced concrete, discussing them in detail. Ills. 3300 w. Eng News ——Jan. 4, 1906. No. 74170.

Leipzig.

The New Railway Station at Leipzig (Der Neue Hauptbahnhof in Leipzig). H. Heinrich. A detailed description of the new union railway station in Leipzig, with plans of the railroad connections. Serial. Part I. 5000 w. Two plates. Glasers Annalen—Jan. 15, 1906. No. 74635 D.

Railway Work.

Railway Grading, Ditching, and Bank Building Machines. Illustrates and describes some machines of great importance in railway construction. 1200 w. Eng News—Jan. 4, 1906. No. 74173.

Shops.

Sedalia Shops, Missouri Pacific Ry. Illustrated detailed description of the shops and their equipment. The group system of motor driving is utilized. 6800 w. Ry & Engng Rev—Jan. 6, 1906. No. 74235.

The Conduct of American Repair Shops (Aus dem Betriebe Amerikanisher Reparaturwerkstatten). G. Dinglinger. Describing especially the methods of railroad shops in the United States, with forms of time cards, job and material tickets, inspection forms, and general works management system. 6000 w. Glasers Annalen—Dec. 15, 1905. No. 74614 D.

The New Shops of the Canadian Pacific Railway at Winnipeg. Wheeler Carr. Illustrated description of shops for repair work which present features of interest. 2800 w. Engr, U S A—Jan. 1, 1906. No. 74321 D.

Signaling.

Mackenzie & Holland's Improved Sykes Block Signal, East Bengal State Railways. G. K. Rogers. Read before the Ry Signal Assn. Diagram and description of this system and its workings. 700 w. Ry & Engng Rev—Jan. 20, 1906. No. 74485.

Signal Arrangements for the New York Central Electrified Zone. Extracts from a paper by W. H. Elliott in *Railway Men* for Jan. Explains some details of the signaling plans. 2700 w. R R Gaz—Vol. XL, No. 2. No. 74330.

Terminals.

Terminal Improvements of the Boston & Maine R. R. in Boston. Illustrated account of recent improvements at this important terminal, which covers 637 acres. 1600 w. Ry & Engng Rev—Jan. 20, 1906. No. 74484.

The East Altoona Freight Terminal of the Pennsylvania Railroad. Illustrated detailed description of these recently enlarged yards, which are said to handle the largest freight tonnage of any single system of freight yards in the world. 4200 w. Ry Age—Jan. 19, 1906. No. 74470.

The New Hoboken Freight Terminal of the Lackawanna R. R. Plan and description of the proposed arrangement of freight terminal piers and slips. 1800 w. Eng Rec—Jan. 6, 1906. No. 74278.

Tunnels.

See Civil Engineering, Construction.

TRAFFIC.

Demurrage.

The Implements and Causes of Demurrage Controversies. Ashley J. Elliott. Discusses some of the problems of car service. 4500 w. Pro St Louis Ry Club—Dec. 9, 1905. No. 74179.

Rates.

Government Regulation of Railway Rates. B. H. Meyer. Read before the Am. Econ. Assn. An argument in favor of government control of railways. 4300 w. Ry Age—Jan. 5, 1906. No. 74208.

Proposed Solutions of the Railway Rate Problem. H. T. Newcomb. Abstract of a paper presented at meeting of the Am. Association for the Advancement of Science. A discussion of certain principles in connection with the measures proposed for new legislation. 5500 w. Ry Age—Jan. 5, 1906. No. 74207.

Tonnage.

Daily Train Tonnage Chart—C. & E. I. Gives a chart devised by H. I. Miller which gives for instant inspection all the essential information relative to one day's northward freight train movements, with explanation. 700 w. R R Gaz—Vol. XL, No. 4. No. 74579.

Traffic.

The Development of American Railway Traffic (Die Entwicklung des Amerikanischen Eisenbahnwesens). Bruno Simmersbach. A tabulated study of the growth in mileage and traffic of American railroads, with data concerning costs and operation. 4500 w. Glasers Annalen—Jan. 1, 1906. No. 74616 D.

MISCELLANY.

Ash Handling.

Economical Ash Handling. Views and description of the ash-pit designed and patented by C. R. Ord, two having been in operation for over two years have given perfect satisfaction. 1100 w. Ry & Loc Engng—Jan., 1906. No. 74201 C.

Colonial Railways.

Colonial Government Railways. Discusses the conditions governing the extension and management of railways constructed and worked by a State, with special reference to the Australian Colonies. 1200 w. Engng.—Jan. 19, 1906. No. 74746 A.

Gulf Routes.

Railroad Routes to the Gulf. Editorial discussion of the changes to secure gulf

connection, and the advantages and disadvantages of gulf ports, especially in regard to the export of grain. 2500 w. R R Gaz—Vol. XL. No. 3. No. 74452.

Legislation.

Recent State Railroad Commission Legislation. Frank Haigh Dixon. Abstract of an article in the Pol Sci Qr. Considers the acts passed in Washington, Indiana, Kansas, and Wisconsin, providing for the creation of state railroad commissions. 3000 w. R R Gaz.—Vol. XL. No. 4. No. 74581.

Review.

A Review of the Railroad Year. An interesting general review of the progress, the construction, electrification, etc. 2500 w. R R Gaz—Vol XL, No. 1. No. 74210.

Statistics.

Length and Cost of Construction of the Railways of the World (Longuer et Prix d'Establissement des Chemins de Fer). A tabulated view of the mileage, territory and population served, and general cost of the railways of the world at the close of 1903. 2000 w. Génie Civil—Dec. 16, 1905. No. 74626 D.

Railroad Statistics. A. A. Goodchild. Read at Dec. meeting of the Canadian Ry. Club. Outlines the great number of incidentals necessarily included in railway management, discussing ways of bettering present methods, and making the statistics more valuable. 5000 w. R R Gaz—Vol. XL, No. 3. No. 74454.

Supplies.

The True Perspective of the Supply Department. George Yeomans, A short paper with lengthy discussion on the importance of this department of railways. 1600 w. Pro W Ry Club—Dec. 19, 1905. No. 74350 C.

STREET AND ELECTRIC RAILWAYS

STREET AND ELECTRIC RAILWAYS.

Belfast.

The Belfast Tramways Undertaking. Illustrated detailed description. 2300 w. Elec Rev. Lond—Jan. 19, 1906. No. 74738 A.

Boston Subway.

Washington Street Subway in Boston. An illustrated description, as given in the report of the Boston Transit Commission. 4000 w. R R Gaz—Vol. XL. No. 4. No. 74582.

Brakes.

Brakes. A. L. C. Fell. Read before the Tramways & Light Rys. Assn. A discussion of the question of brakes in construction with tramcars, considering the results thus far obtained. 3800 w. Elec Engr, Lond—Jan. 12, 1906. Serial. 1st part. No. 74511 A.

Buenos Aires.

Buenos Aires Electric Tramways. Dr. Alfred Gradenwitz. Illustrates and describes the electrification and extension of the tramway system. 2500 w. Elec Rev, N. Y.—Jan. 27, 1906. No. 74726.

Electric Railways.

Electric Railway Engineering. F. E. Wynne. The first of a series of articles based on a course of lectures delivered by Mr. Clarence Renshaw dealing with the general principles relating to the operation of cars or trains. 3300 w. Elec Jour—Jan., 1906. Serial. 1st part. No. 74536.

Technical Considerations in Electric Railway Engineering. F. W. Carter. Deals in a general way with the technical side of the electrification problem, giving details of the methods employed in investigating the engineering features of the electrical system. 12300 w. Inst of Elec Engrs—Jan. 25, 1906. No. 74880 D.

The Railway in 1905. Dr. Louis Bell. A review of the year, noting the progress, the most important issue being the advance toward alternating current traction. 1800 w. Elec. Rev., N. Y.—Jan. 13, 1906. No. 74429.

Falkirk.

The Falkirk Tramways. Illustrated description of a new line in Scotland. 1200 w. Elec Rev., Lond—Dec. 22, 1905. No. 74142 A.

Fares.

The Canadian System of Collecting Fares. Includes I. Collecting and Handling Fares on the Toronto Railway, by R. T. Clark; II. Handling Fares on the Montreal Street Railway, by H. E. Smith; and Fare Collecting, by D. McDonald. Also editorial. Ills. 6000 w. St Ry Jour—Jan 27, 1906. No. 74722 C.

Hanger Bolts.

The Preservation of Hanger Bolts on Electric Tramways. Robert N. Tweedy. Gives an account of failure of insulated hanger bolts, and the remedy. 1100 w. Elec Rev., Lond.—Dec. 29, 1905. No. 74288 A.

We supply copies of these articles. See page 957.

High Speed.

High Speed Electric Railroads. Henry G. Morris. Discusses some of the conditions governing steam and electric railway practice in the United States, and the present speed limitations; reviews facts developed in the German experiments, and presents the "Motor cycle Railway" for consideration. 6800 w. Pro Engrs. Club of Phila—Jan. 1906. No. 74534 D.

Improvements.

Extensions and Improvements on the Chicago & Milwaukee Electric Railroad. An illustrated article concerning the reconstruction, extensions and improvements on the various divisions of this road during the past year. 3000 w. St. Ry Jour—Jan. 20, 1906. Uo. 74469 C.

Interurban.

The Toledo, Port Clinton & Lake Side Railway. Illustrated detailed description of a line which has opened up territory in northern Ohio, hitherto without adequate transportation facilities. 3700 w. St. Ry. Jour—Dec. 30, 1905. No. 74120 C.

Locomotive.

Electric Locomotive (Ganz System) for the Valtellina Line, Italy. Illustrated detailed description of the new locomotives and information of tests. 2500 w. Ry. Age —Dec. 29, 1905. No. 74097.

20,000-Volt Single-Phase Locomotive for Sweden. Illustration and description of a locomotive supplied by the Siemens-Schuckert Co., weighing 36 tons, and intended to haul goods trains at speeds up to 40 miles per hour. 1400 w. Elect'n., Lond—Jan. 5, 1906. No. 74406 A.

London Subway.

The First London Tramway Subway. Illustrated description of the line from the Strand to Islington. Map and sections, with description of the steel cars for the service. 2000 w. Tram & Ry Wld —Jan. 11, 1906. No. 74741 A.

Losses.

Energy Losses on Tramways. Gives figures derived from undertakings in England, with general remarks. 1500 w. Elec. Rev, Lond.—Jan. 12, 1906. No. 74515 A.

Motor Car.

The Delaware & Hudson Gasoline-Electric Car. An illustration, with account of the trial run of this novel car, which was quite successful. 1500 w. St Ry Jour—Feb. 10, 1906. No. 74926 C.

Philadelphia Subway.

The Lighting System and overhead Construction of the Philadelphia Subway. An illustrated article giving particulars of this work. 800 w. St. Ry. Jour—Dec. 30, 1905. No. 74121 C.

Pittsburg.

The Brunot's Island Power House of the Pittsburg Railways Co. Illustrated detailed description of a large power station and its equipment. 3000 w. Ry & Eng. Rev—Jan. 13, 1906. No. 74377.

Power Plant.

Quincy Point Power Plant of the Old Colony Street Railway Co. Howard S. Knowlton. Illustrated description of one of the largest and most interesting power plants in New England. The generating equipment consists of five 2,000 K. W. Curtis turbo-alternators. 2500 w. Engr. U S A—Jan. 15, 1906. No. 74476 C.

Reconstruction.

Extension and Improvements of the Chicago & Milwaukee Electric Railroad Co. An illustrated account of the work accomplished during the last year, in the reconstruction of this property. 4500 w. St Ry Rev—Jan. 15, 1906. No. 74496 C.

Shops.

New Shops of the Oakland Traction Consolidated and Key Route Systems. Illustrated detailed description of new shops in California and their equipment. 6000 w. St Ry Jour—Feb. 3, 1906. No. 74849 C.

Repair Shop Practices of the Toronto Railway. Illustrated description of these shops and some of the important economies and improvements recently introduced. 3000 w. St Ry Jour—Feb. 10, 1906. No. 74923 C.

Repair Shop Practices of the Montreal Street Railway. An illustrated article dealing with practices and devices in shops having a wider range of work than is usually customary. 2800 w. St Ry Jour—Jan. 27, 1906. No. 74723 C.

Signaling.

Automatic Signaling on the District Railway. A short description of the system and its working. 1000 w. Engr, Lond. Jan. 19, 1906. No. 74754 A.

Singapore.

Electric Tramways in Singapore. Illustrated description of the recently completed electric railway system. Among its special features is the employment of narrow gage and of welded rails. 1800 w. St. Ry Jour—Jan 27, 1906. No. 74724 C.

Single-Phase.

Single-Phase Railway in Paris. P. Letheule. Brief illustrated description of single-phase traction with motors of the Latour type. 500 w. St Ry Jour—Feb. 10, 1906. No. 74925 C.

Electrical Equipment for the Sarnia Tunnel, Grand Trunk Railway. Illustrated description of an electrical installation to operate freight and passenger trains through the tunnel that connects

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the American and Canadian divisions, using the single-phase alternating current system. 2800 w. Ry. & Engng Rev.—Jan. 13, 1906. No.74374.

Single-Phase Electric Locomotives and Power Equipment of the St. Clair Tunnel Company. Illustrated detailed description, with general information. 2300 w. R R Gaz—Vol. XL. No. 3. No. 74455.

Single-Phase Locomotive for 20,000 Volts (Einphasenlokomotive für 20,000 Volt). Illustration and general description of the locomotive built for the Swedish State Railway. 1800 w. Elektrotechnik und Maschinenbau—Jan. 1, 1906. No. 74660 D.

Single-Phase Railway Motors. Friedrich Erichberg. Describes the system of the Allgemeine Elektricitäts-Gesellschaft, and states some of its advantages. 2400 w. Elec Engr, Lond—Dec, 22, 1905. No. 74140 A.

The Stubai Valley Railway. Egon E. Seefehlner, in *Elektrische Bahnen und Betriebe.* Illustrated description of the first line equipped for working with single-phase alternating current of high tension and frequency, which has been in satisfactory operation for 15 months. 3000 w. Elec Engr., Lond—Dec. 29, 1905. Serial. 1st part. No. 74285 A.

The Use of Alternating Current for Heavy Railway Service. B. G. Lamme. A discussion of systems that have been developed, which are applicable to heavy service, considering the merits of the single-phase system with commutator type motors, the cost of such a system, etc. 7500 w. St Ry Jour—Jan. 6, 1906. No. 74228 C.

See also Electrical Engineering motors.

Sub-Stations.

Some Considerations Determining the Location of Electric Railway Sub-Stations. C. W. Ricker. Outlines a general method for determining the number and location of sub-stations. 1800 w. Am Inst of Elec Engrs—Dec., 1905. Serial. 1st part. No. 74184 D.

The Relation of Railway Sub-Station Design to its Operation. Sydney W. Ashe. Considers only sub-stations in which high-tension alternating current is received and converted into low-tension direct current. Discusses factors of importance in securing reliability of service. 4000 w. Ills. Am. Inst of Elec Engs. —Dec., 1905. No. 74183 D.

Subways.

Projected Subway Lines in Greater New York. S. D. V. Burr. Discusses the proposed additions to the present subway system, which include nineteen routes. 4500 w. Ir Age—Feb. 1, 1906. No. 74787.

Superposition.

The Work of Superposing Three Lines of the Metropolitan Railway of Paris, at the Place de l'Opera. R. Bonnin. Describes the work of superposition of three lines crossing at the Place de l'Opera. Ills. 1500 w. Eng News—Feb. 1, 1906. No. 74809.

Surface Contact.

The Lincoln Electric Tramways. Short illustrated description of the G. B. surface-contact system, and its operation. 1500 w w. Elec Engr, Lond—Jan. 12, 1906. No. 74509 A.

Switches.

Throwing Devices for Tongue Switches. T. A. Gerlach. Points out the various cases where throwing devices should be used, and describes and illustrates some of the devices, discussing their proper construction. 1500 w. St Ry Rev—Jan. 15, 1906. No. 74495 C.

Tracks.

Bonding and Other Track Improvements on the Calumet Electric Railway. Illustrates and describes the method of cast-welding rail joints in use on this electric railway, and some interesting reconstruction work. 1200 w. St Ry Jour —Feb. 10, 1906. No. 74924 C.

Trucks.

Improvements in Trucks. Elmer E. Cook. Abstract of paper and discussion before the Tramways & Light Rys. Assoc. Calls attention to defects due to bad fitting, and considers the radial truck the greatest recent improvement. Ills. 2000 w. Elect'n, Lond—Dec. 22, 1905. No. 74143 A.

Tunnels.

See Civil Engineering, Construction.

Ventilation.

The Ventilation of the Baker-Street and Waterloo Railway. G. Rosenbusch. Outlines the construction and mode of operation of these tube railways, and illustrates and describes the means adopted to improve the ventilation. 2500 w. Engng.—Dec. 22, 1905. No. 74149 A.

Wisconsin.

Reconstruction Work of the Madison & Interurban Traction Co. Illustrated description of a city system that has been in operation 20 years, and has practically been rebuilt during the past summer. 2400 w. St Ry Rev—Jan. 15, 1906. No. 74494 C.

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EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily attainable, and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cts. per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

American Architect. *w.* New York.
American Electrician. *m.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U.S.A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. d Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *m.* New York.
Automobile Magazine. *m.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Am. Iron and Steel Asso. *w.* Phila., U. S. A.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Review. *m.* Montreal.
Cassier's Magazine. *m.* New York and London.
Cement. *b-m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.

Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad.des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.
Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *m.* Chicago.
Eisenbahntechnische Zeitschrift. *b-m.* Berlin.
Electrical Engineer. *w.* London.
Electrical Magazine. *m.* London.
Electrical Review. *m.* London.
Electrical Review. *w.* New York.
Electrical World and Engineer. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electricity. *w.* London.
Electricity. *w.* New York.
Electrochemical and Met. Industry. *m.* New York.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricita. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Chicago.
Engineering. *w.* London.
Engineering and Mining Journal. *w.* New York.
Engineering Magazine. *m.* New York & London.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Engineering Review. *m.* London.
Eng. Soc. of Western Penna. *m.* Pittsburg, U.S.A.
Far Eastern Review. *m.* Manila, P. I.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. Dei Lav. Pubb. e. d. Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Ice and Refrigeration. *m.* New York.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron & Steel Magazine. *m.* Cambridge, Mass.
Iron and Steel Trades Journal. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. Am. Foundrymen's Assoc. *m.* New York.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal of Gas Lighting. *w.* London.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Journal of U. S. Artillery *b-m.* Fort Monroe,U.S.A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U.S.A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Marine Engineering. *m.* New York.
Marine Review. *w.* Cleveland, U. S. A.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* New York.
Mining Reporter. *w.* Denver, U. S. A.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *m.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Pacific Coast Rwy. Club. *m.* San Francisco.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago
Railway and Loc. Engng. *m.* New York.
Review of Reviews. *m.* London & New York.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue Gen. des Chemins de Fer. *m.* Paris.
Revue Gen. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Revue Universelle des Mines. *m.* Liége.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Engng. *m.* Ithaca, N. Y.
Stahl und Eisen. *s-m.* Düsseldorf.
Stevens' Institute Indicator. *qr.* Hoboken, U.S.A.
Street Railway Journal. *w.* New York.
Street Railway Review. *m.* Chicago.
Tijds v h Kljk. Inst. v Ing. *qr.* Hague.
Traction and Transmission. *m.* London.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
World's Work. *m.* New York.
Yacht. *w.* Paris.
Zeitschr. d. Mitteleurop. Motorwagen Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Elektrotechnik. *w.* Vienna.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Gazetteer.

A Complete Pronouncing Gazetteer or Geographical Dictionary of the World. Edited by Angelo Heilprin and Louis Heilprin. Size, 11 in. by 8 in.; pp. x, 2,053. Price, $10.00. Philadelphia and London: J. B. Lippincott Company.

Lippincott's Gazetteer has been before the public for half a century, the first edition having been issued in 1855, and through succeeding editions it has maintained during that period its high reputation as a standard work of geographical reference. The present edition, however, is practically a new work, based upon the framework of its predecessor, and retaining the system of pronunciation prepared by the late Dr. Joseph Thomas for the earlier work, but being otherwise entirely rewritten and edited by the eminent geographers whose names appear on the title page.

It is manifestly impossible to give an adequate notice of such a monumental work within the limits of space here available, but it may be practicable to note some of the relations of such a volume to the work of the engineer. Thus, in its pages will be found valuable and recent information concerning the topography of many countries, corrected mountain altitudes, changes which have been made in portions of the earth by reason of engineering operations, and data relating to projected works. Under the title of Panama, there is given, in condensed but clear form, data concerning the climatology of the isthmus, as well as the general topography and geology of the region.

Many places which have come into recent notice by reason of their relation to hydro-electric stations, irrigation works, or other engineering associations, are found in their proper places, although not generally noticed in publications of this kind, while an active use of the gazetteer for the verification of references in the technical periodical press of Europe and America has failed to reveal any error worthy of note or any material lack of fulness.

The work has apparently been brought closely down to date, including the conclusion of the treaty of peace between Russia and Japan, the results of the British expedition into Tibet, and the most recent arctic and antarctic expeditions.

The editors state that the gazetteer is especially complete in references relating to the United States and Canada, which is doubtless correct, but a continual reference to the work for places of varying importance in other parts of the world show a completeness in all respects which is most satisfactory and commendable.

An interesting feature in the gazetteer is the information which it contains as to the mineral resources of the various countries described. The deposits of gold, copper, silver, iron-ore, nickel and coal, as well as of petroleum and other mineral riches, are fully indicated, and in general the natural resources of the different regions of the earth, as well as the usual information concerning population, political importance and manufacturing eminence, are fully recorded. The gazetteer thus constitutes a work of reference of daily value in the library of the engineer, as well as the general reader and writer, one of the books which must be had if one would maintain a reputation for accuracy and reliability in matters of daily comment.

Cements.

Cements, Limes, and Plasters. By Edwin C. Eckel, C. E. Size, 9 in. by 6 in.; pp. xxxiv, 710. Price, $6.00. New York: John Wiley & Sons. London: Chapman & Hall, Limited.

Among the materials of construction used by the engineers at the present time there is little doubt that cement and its associated products stands second only to iron and steel. Masonry, either of stone or brickwork, is rapidly being mod-

ified into an associate of structural steel in the form of reinforced concrete, and there is every reason to believe that steel and cement, united in proportion and arrangement as may be determined by engineering precedent and computation, will be the building materials of the immediate future.

From his position on the United States Geological Survey, as well as by reason of his own personal acquirements, Mr. Eckel is eminently fitted to collate and discuss the questions relating to the preparation and uses of cements, mortars, and plasters, and his work represents the results of painstaking effort, in connection with exceptional opportunities to obtain the latest technical information upon the subject.

Although sufficient space is given to the general chemical and physical principles which underlie the preparation and uses of cements, the work gives prominence to the discussion of practical methods of manufacturing the products, as at present employed, with details as to labor, power, and costs, this rendering the book of value to the manufacturer. The data and results included in papers published in European and American engineering journals, many of which are difficult of access, and written in foreign languages, are here gathered together and abstracted, so that the reader is placed in possession of much information not otherwise readily accessible.

The book contains many tables, diagrams and maps, and is fully illustrated.

BOOKS RECEIVED.

L'Incendie, ses causes, sa prevention, son extinction. Par Félicien Michotte. Price, 15 francs. Paris: Vve. Ch. Dunod.

Physics. By Charles Riborg Mann and George Ransom Twiss. Price, $1.25. Chicago: Scott, Foresman & Co.

Hydraulic Power Engineering. By G. Croydon Marks. Price, $3.50. New York: D. Van Nostrand Co. London: Crosby Lockwood and Son.

Theory of Structures and Strength of Materials. By Henry T. Bovey, F. R. S. Fourth Edition. Price, $7.50. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Radio-Activity. By E. Rutherford, F. R. S. Second Edition. Price, 12s. 6d., $4.00. Cambridge: The University Press. New York: The Macmillan Company.

The Design and Construction of Metallic Bridges. By William H. Burr and Myron S. Falk. Price, $5.00. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Advanced Mechanical Drawing. By Alpha Pierce Jamison. Price, $2.00. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Machine Shop Tools and Methods. By W. S. Leonard. Price, $4.00. New York: John Wiley & Sons. London: Chapman & Hall, Ltd.

Principles of Electrical Power. By A. H. Bate. Price, 4s. 6d. London: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain.

Wireless Telegraphy. By A. Frederick Collins. Price, $3.00. New York: McGraw Publishing Company.

IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Ore Unloaders at Lorain.

THE high state of development in rapid unloading and handling of iron ore at lake ports is of special interest. A notable type of rapid ore handling equipment is the Hulett automatic ore unloader, invented by Geo. H. Hulett, third vice-president of the Wellman-Seaver-Morgan Company, Cleveland, who are the builders of the machines. An idea of their powerful character may be had from the fact that they handle a grab bucket which automatically digs and conveys from the hatches of the boat ten gross tons of ore at a load. The speed of operation attainable can be judged from the fact that four of the machines have a record of unloading 7,257 gross tons of ore in 4½ hours—over 403 tons per hour per machine.

The accompanying cuts show a late installation of these machines at the docks of the National Tube Co., Lorain, Ohio. The Hulett unloaders may be arranged for steam or electric operation as required. Those at Lorain are electrically operated and embody a number of special features, largely necessitated by local conditions, and in a measure illustrating the permissible adaptability of design to meet special conditions which may obtain at various ports.

The Lorain docks in front of these unloaders are curved to such an extent that while the ends of a boat touch the dock, the boat at an intermediate point is 12 feet away from it. The tracks on which the unloaders travel are correspondingly curved, hence some provision was necessary to enable the unloaders to be readily squared with any of the hatches of the boat. This is accomplished by mounting each machine on special swiveling trucks, thus enabling the leg and bucket to be easily squared

HULETT AUTOMATIC ORE UNLOADERS AT LORAIN, OHIO.

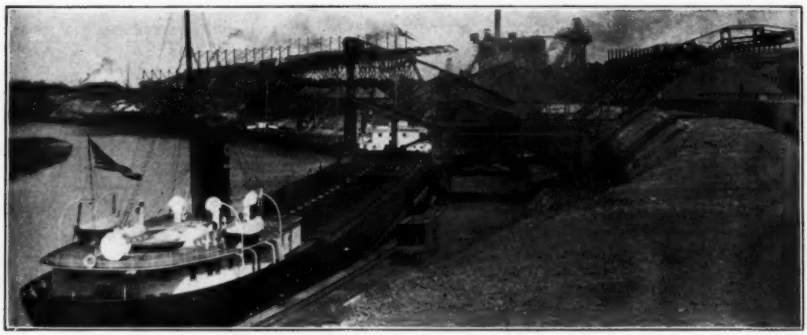
with any of the hatches. The machines are provided with special cantilever extensions particularly designed for delivering the ore on the high bank back of the machine. It will also be noted that the walking beams of these machines are located at the top and the parallel bars below, an arrangement permitting of very advantageous distribution of materials employed, and also simplifying the matter of counterbalancing.

The general operation of these machines is similar to that of previous installations. Each machine has two parallel girders at right angles to face of dock and mounted on moving trucks. On these girders a trolley or carriage travels back and forth carrying a long pivoted walking beam. On the front or water end of the walking beam is carried a vertical dependent leg to which is attached the bucket. This leg is always maintained in a vertical position. The operator who controls all the motions of the bucket rides at the lower end of the leg directly above the bucket. By means of hoisting mechanism the walking beam is made to oscillate up and down carrying the bucket down into the hold of the boat and up above the dock. The travel of the trolley back and forth on the girders carries the walking beam and the bucket out over the boat and back over the dock.

To reduce the trolley travel as much as possible, suitable hoppers for receiving the contents of the buckets are mounted between the girders at the front. These hoppers discharge into an auxiliary bucket car which travels back and forth on the cantilever extensions, carrying the ore back and dumping it on the high bank above referred to.

The bucket car is automatic in its operation, dumping itself at any point desired on the cantilever and returning closed to its position under the hoppers ready to receive another load. The dependent leg of the unloader is located on rotating trunnions in the walking beam, so that it can rotate in a circle when operating in the hold of the vessel, allowing the bucket to reach out in all directions.

The bucket is of ten gross tons capacity, and is opened and closed by specially designed motors. The total spread of the bucket when wide open is over 18 feet, and by telescopic motion can be made to reach, when open, more than half way from the center of one hatch to the center of the other. It also travels lengthways of the hatch to the sides of the boat, consequently the operaor is able to reach almost the entire cargo. In an ordinary boat there is no difficulty in reaching 90 per cent. of the cargo, and in some of the modern boats the machines have actually unloaded 97 per cent. without the aid of shovelers.



HULETT ORE UNLOADERS AT LORAIN, OHIO.

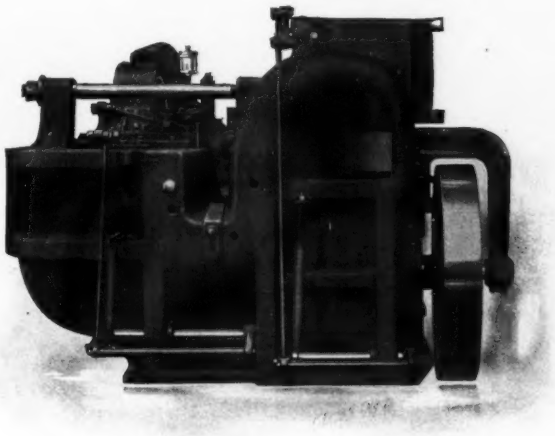
The power is supplied from motors which take their current through sliding contacts from rails laid along the dock. The motors for operating the bucket are 110 horse power; those for hoisting the walking beam are 150 horse power; for trolleying in and out, 50 horse power; and for operating the bucket car and moving the machine, 150 horse power.

Ajax Forging Machine.

THE accompanying illustration shows the new Ajax universal forging machine. It will be observed that this machine, while retaining all the features of the Ajax heading, upsetting and forging machine, has in addition a powerful vertical press which can be used for forging, bending and trimming. It has a vertical movement of from 3 to 5 inches, according to the size of the machine. There is a screw adjustment to the stroke of the head which enables the operator, when setting the dies, to bring them to the exact point desired. This screw is readily accessible from all parts of the machine. The vertical movement of the head is obtained by heavy links connected at the lower end with levers on which are eccentric hubs which give the head the desired throw or stroke. These levers in turn are connected to a slide placed horizontally in the machine and actuated by an eccentric shaft in the back end of the machine.

The mechanism that operates the vertical forging press is entirely separate and independent of that which operates the forging machine, although both are in the one bed. The forging press is brought into operation by the operator's depressing the pedal on the right of the machine, seen in the illustration. This allows the lock, between the eccentric shaft and header slide, to drop into place. The operaor can give one or more blows as desired. On taking the foot off the pedal the lock is released automatically and the forging press comes to a stop with the dies wide open. The locking device for the forging press is a reproduction of the Ajax lock, an excellent feature of the Ajax heading, upsetting and forging machine.

This machine opens up a new field for forging work, as by its use forgings can be made at a much lower cost than formerly through the saving of heats and handling, and many intricate forgings heretofore impossible to make on forging machines can be turned out by this tool.



AJAX UNIVERSAL FORGING MACHINE.

These machines are built in seven sizes, the design of the bed being of the box form type, cast solid in one piece and made of a special mixture of strong, close-grained iron and of ample strength to withstand the excessive stress and strain incident to the operation of this class of machinery. It is built by the Ajax Manufacturing Co., Cleveland, and is the invention of J. R. Blakeslee, Jr., general manager of the company.

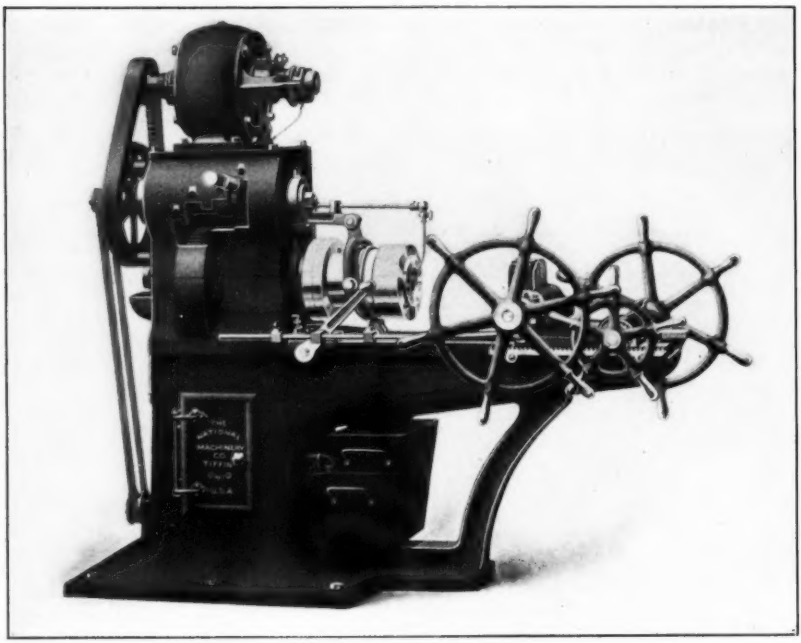
Motor Driven Bolt Threaders.

AS bolt threading machines are frequently placed in forge shops or in isolated places where it is difficult to convey power to them, and further as there is a general demand for direct motor-driven machines, the National Machinery Company, Tiffin, Ohio, have placed upon the market a line of bolt threading machines arranged for direct motor drive.

Reference to the accompanying illustration shows the method of applying the motor, and to provide a thoroughly flexible equipment the machines are fitted with a suitable speed change device, so that the proper cutting speeds can be secured through the change gears, even when the motor is of the constant speed type.

The illustration shows a machine of 1½" capacity, and the gearing in the speed box provides four changes of speed, enabling the machine to handle work of all sizes within its capacity at the proper cutting speed. It is not necessary to use a variable speed motor, but if the utmost refinement is wished by using a motor having a speed variation of from 1 to 1.4, the total speed variation will be as 1 to 5.5.

In designing this line of machinery the aim has been to combine effectiveness with simplicity, and this result has been secured to a surprising degree, as a minimum number of the gears and the various speed changes are secured by the shifting of one hand lever only. The gears are of large size and wide face, and there are no gears or pinions sliding on feathers. No prong clutches are employed.



MOTOR DRIVEN BOLT THREADERS.

The illustration shows the motor connected to the speed box by a silent running chain, but it is possible to furnish this equipment using a rawhide idler, and a gear drive direct from the motor. By placing the motor over the head spindle of the machine the floor space is reduced to a minimum, and the motor is out of the way

of oil and dirt; and, in addition, all of the driving gears are incased. These machines are built in all sizes from 1" to 6" capacity, each size having a proper number of cutting speeds to handle the work for which it is designed.

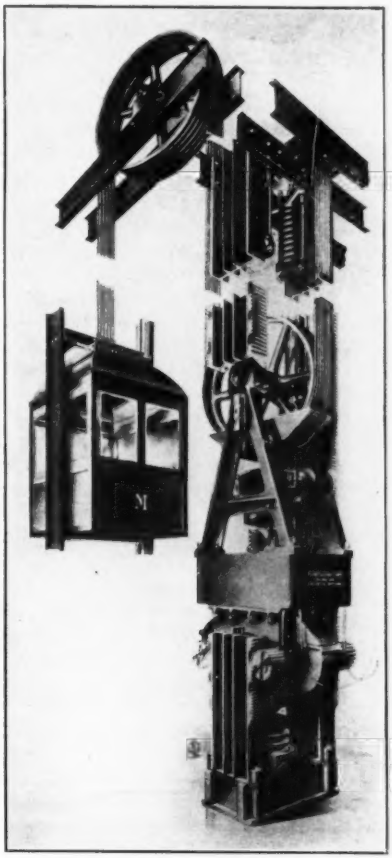
The Mabbs Electric Elevator.

A NOVEL departure in elevators has been made by John W. Mabbs, Chicago. The cut of this elevator shows the general arrangement of the machine, car, cables, buffers, etc. The novel feature of this machine is that the motor takes the place of the ordinary counter weight as installed in other elevators. The motor travels up and down two vertical cast iron columns, by means of four pinions, which engage four racks—which racks are mounted upon the outer spaces of the two cast iron columns. The pinions are mounted upon the outer ends of the two horizontal shafts. In the center of each of these shafts is mounted a worm wheel and between these two worm wheels is a worm, mounted upon a vertical armature shaft rotated by a specially designed motor. As the armature revolves the worm turns the horizontal shaft and pinions by means of the worm wheels, causing the motor to ascend or descend according to the direction the armature is revolved. As the motor ascends the car descends and vice versa.

The motor is not rigidly attached to the hoisting cables, but hangs in a bight of the cables, one end of the cables being attached to the building, and the other to the tower. By this arrangement the car travels two feet to every foot of motor travel. The current is carried to the motor by two copper-lined channels mounted on porcelain blocks located on the columns between the motor guides and racks. The current is taken from these channels by means of brushes mounted on the motor frame.

At the upper and lower ends of the travel of the motor are located air buffers which form an absolute mechanical stop for the motor.

The principal features of this machine are, its safety—due to the mechanical buffers. It is impossible to overrun its travel in either direction. Any desired speed can be safely obtained, and when running at full speed it can be instantly reversed without the slightest shock or jar to the occupants of the car. The current consumption of this elevator is unusually small, the average for a period of over two years being only 3.43 kilowatts per car mile. Due to the simplicity, strength and careful de-



MABBS ELECTRIC ELEVATOR.

tail in the design of the machine the repairs are practically nothing. The machine is controlled by a full magnet control.

Marine Boilers in Stationary Plants.

DURING the past few years a decided tendency has been noticeable on the part of steam users to profit from marine practice in the generation of steam, avoiding any form of brick setting in boiler

plants and to obtain the economy represented in the use of a properly designed internally fired marine type of boiler. Perhaps never before were so many Scotch marine boilers specified in stationary power plants as at the present time. This type has been adopted as a standard by numerous municipalities for pumping plants and by several State boards for institutions under their control.

The rating, however, of these boilers has followed too closely the marine practice where some kind of a forced draft is available to increase the power of the boilers, so that a rating per horse power is established on about 7 sq. ft. of heating surface. This is too small to meet the conditions in stationary power plants in order to obtain the best efficiency. This type of boiler should be rated on a basis of 10 sq. ft. to the horse power, but this would limit shipment by rail to units of about 175 horse power, preserving the proper proportions of the boiler.

Unfortunately it is but seldom that the acknowledged defective circulation in a Scotch marine boiler is improved by pumping the water from the bottom of the shell in order to bring it in contact with the heating surfaces, which would correct the unequal strains this type is subjected to through unequal expansion.

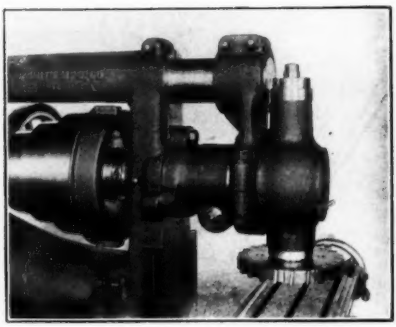
A marine type of boiler especially adapted for stationary work is the Fitzgibbons, in which both the circulation and combustion have been greatly improved over a Scotch marine, and as it can be shipped in units as large as 300 horse power, it at once becomes the only marine type of shell boiler that can compete, where rail shipment is necessary, in units of this size, with sectional water tube designs.

Many of the leading engineers of the country are exceedingly interested in the performance of Fitzgibbon boilers and are convinced by tests of the exceptional efficiency of this design, and that it offers several peculiar advantages both in improved circulation, which makes it an exceptionally quick steamer, and in the dry quality of the steam. Especial attention is called to the furnace design, which affords a combustion chamber over the furnace where complete combustion may be effected by the proper admission of air in an opening provided for that purpose over the fire door.

To engineers who prefer to use a marine shell boiler, the Fitzgibbons will remove any objections which they may legitimately find with the Scotch marine type. Data and other information will be furnished to inquirers by the Fitzgibbons Boiler Co., 26 Cortlandt street, New York.

New Vertical Milling Attachment.

THE illustration herewith shows an interesting vertical milling attachment, extra heavy and powerful pattern, just brought out by the Kempsmith Mfg. Co., Milwaukee. It is designed for strength and rigidity sufficient to handle, without undue strain, the very heaviest classes of vertical milling which the power of the main spindle itself will stand; thus, in effect, converting a powerful horizontal miller into just as powerful a vertical miller. With this end in view the attachment is constructed throughout along the most compact, simple, and powerful lines.



VERTICAL MILLING ATTACHMENT.

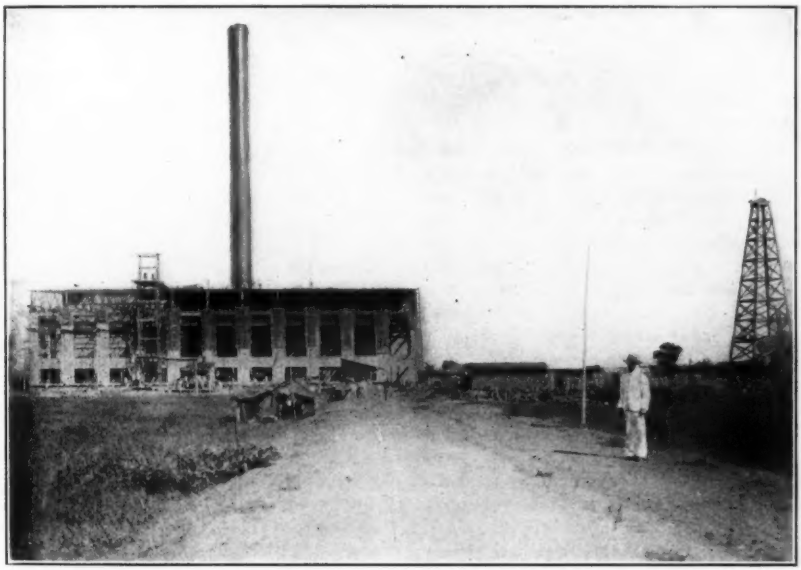
The bevel gears in the head are of large face and coarse pitch, of steel, case hardened. The vertical spindle runs in unusually long bearings, in order to maintain a perfect alignment. Provision is given for delicate adjustment for wear. The head is graduated and can be swiveled to any angle. Its construction requires only two bolts to be handled in adjusting and clamping the head securely at any angle. Both bolts are very conveniently located.

The horizontal bolt clamping the head in the bracket has unusually rigid clamping power, being a friction bolt of improved type. The vertical spindle has taper hole and is threaded for greater face milling cutters. Both the taper hole and thread are the same as on the main spindle, thus all tools are interchangeable. Drawbolts are furnished for drawing in and backing out of end mills. The design of the head keeps the distance from the center of the horizontal spindle to the nose of vertical spindle very short, so as to permit of doing work unusually high from the table.

The attachment is drilled to the same jig as the columns of machines for which it is intended, so that it can be applied to any Kempsmith miller, of certain sizes, now in use. The attachment is built in three sizes, and any further information regarding specific power, tests, and so on, will be furnished by the makers.

Street Railways in Manila.

A LONG step forward in the Americanizing of the Filipino was taken in the opening of the Manila street railway. The plant of the Manila Electric Railway & Light Co. serves the purpose of supplying transportation and lighting service to Manila. During the last two and one-half years some 1,500 to 2,000 natives have been occupied in erecting the power house and car barns and installing a complete electric system. Their wages ranged from 50 to 70 cents per day, varying according to their occupation. The Filipinos were well satisfied with this small sum—almost twice as much as they received under Spanish rule. The main trouble was to keep them at work steadily. With their increased wages they felt that two or three days of consecutive labor was sufficient. By allowing them to observe innumerable feast-days, and letting them take a rest in the middle of the day when the heat was intense, the foreman found that they were more willing to work.



POWER HOUSE OF MANILA ELECTRIC RAILWAY.

A hard problem was to find wood for ties, poles and for the car bodies which would withstand the assault of the white ant and be practically weatherproof. As an experiment, three kinds of wood were used for ties: the native wood called *molave*, California redwood, and an Austra-

lian wood. Further experimenting has been done, by treating the ties with preservatives, such as creosote, jodelite, solignum and carbolineum. The rails were painted with asphaltum, and in low lying ground were laid in concrete. The only wood which seemed to be ant-proof was teak, and the cars were built of this material, combined with steel of a heavy design and carefully protected with rust-proof paint.

The Manila climate is intensely hot, and hurricanes are a common occurrence. The greater part of the equipment consists of open cars, but several convertible and semi-convertible cars are being used for experimental purposes. Simplicity was the keynote of the designs for the cars, so that there would be no difficulty in keeping them clean. Heavy storms occur so frequently that extra precautions were taken to secure the comfort of the passengers. All cars are vestibuled and equipped with curtains of Pantosote mounted on extra heavy slats which will resist the strongest wind. The gutters, water ducts, and cables for curtains are made of non-rusting metals, and the dash-boards of extra heavy steel. There is a considerable overhang to the monitor roofs, and the ventilation is so arranged as to readily dispose of any water which may collect.

The Manila electric railway repair shops are thoroughly equipped to design and build their own cars, and are conducting experiments with a view to using native woods. The present equipment consists of 95 passenger cars furnished with Westinghouse two-motor equipments throughout. On account of the lower price of teak wood in Europe most of the car bodies were purchased there, but the trucks were purchased in America. The power house contains four Westinghouse turbo-generators which produce approximately 4,000 horse power. Electricity for general power purposes and lighting is furnished by the company as well as the power for the street railroad. The power house, car barns, and other buildings are built entirely of steel and concrete, all metal being painted. Viewed as a whole, or in detail, the plant of the Manila company, which was built and is being operated by J. G. White & Co., New York, is fully up to the most advanced standard of American practice.

Chicago Pipe Bending Machine.

A NEW illustration of the Chicago pipe bending machine is shown herewith. It will be noted that this machine is very simple in its construction, but at the same time it will accomplish an extended line of work. Its light weight renders it extremely portable, thus enabling its being readily carried from shop to job, and can be secured to any column, stanchion, or any available support in a few minutes; or a suitable stand can be furnished, as shown by the illustration.

Piping of steel, iron, brass, copper, or other material can be bent cold up to 2″

CHICAGO PIPE BENDING MACHINE.

diameter with one man. Where pipes are coated by the Sabin process, galvanized, tinned, etc., this machine will bend it to any desired shape without breaking the coating in any way. One man can bend a piece of 2″ pipe to an S bend in three minutes, no other assistance or device being used.

The cost of repairs where it has been used 10 hours per day in shipyards, railway shops, and other places has been so slight, as to be a negligible quantity. The Chicago Pneumatic Tool Co. are prepared to handle orders for this device and make prompt deliveries. It has been thoroughly tested in the navy yards, where those in charge of the pipe work have recommended it highly.

NEWS SUPPLEMENT

The Engineering Magazine—October, 1905.

Personal.

—W. S. Doran, formerly associated with the British Westinghouse Electric & Manufacturing Co., Ltd., has just been appointed manager of the power department of Allis-Chalmers Co., Milwaukee.

—Walter E. Harrington has severed his connection as vice-president and general manager of the New York-Philadelphia Co. to become associated with J. G. White & Co., New York, as operating manager.

—Vernon H. Rood, vice-president and general manager of the Jeanesville Iron Works, Hazleton, Pa., died suddenly at Bad Naudheim, Germany, where he had gone for the benefit of his health.

—H. F. Stratton, who has been connected with the main office of the Electrical Controller & Supply Co., Cleveland, has accepted the position of New York representative of the same company, with offices at 136 Liberty Street.

—James C. Hain has resigned as engineer of masonry construction for the Chicago, Milwaukee & St. Paul Railroad and is now associated with J. G. White & Co. as superintendent of masonry construction, with headquarters at 43 Exchange Place, New York.

—G. M. Basford, for the past eight years editor of the *American Engineer and Railroad Journal*, has accepted a position with the American Locomotive Co., in charge of a newly established department of publicity. He will assume his new duties October 1, at the general offices of the company, 111 Broadway, New York.

Industrial Notes.

—S. Obermayer Co., Cincinnati, at their Chicago plant, have added a large woodworking department, with special and improved machinery to facilitate prompt shipments of flasks of all kinds.

—The factory of the Hercules Gas Engine Works, San Francisco, was destroyed by fire, but a temporary shop has been secured and permanent buildings and equipment will be installed as rapidly as circumstances will permit.

—Allis-Chalmers Co., Milwaukee, has appointed as manager of its newly created foreign department, Eugene Holcomb, who takes charge of all the foreign agencies and foreign selling representatives of the company, with headquarters in Milwaukee.

—J. G. White & Co., New York, are building a reinforced concrete power house for the Waltham Gas Light Co., Waltham. The entire building is to be of reinforced concrete construction, no exposed steel framework will be used. Steam will be supplied by four 350-horse power boilers, set in batteries of two each, a reinforced concrete stack furnishing natural draft.

—Crocker-Wheeler Co., Ampere, N. J., is in receipt of an order for a 200 kilovolt ampere, 3-phase, 60 cycle, engine type alternating current generator for the Ivorydale, Ohio, lighting and power plant of the Proctor & Gamble Co. This machine is a duplicate of the first Crocker-Wheeler alternator ever built, which was installed ten months ago in the Atlanta plant of the same company.

—Allis-Chalmers Co., Milwaukee, has shipped to their San Francisco offices a consignment stock of Gates rock and ore breakers of various sizes, together with standard repair parts which may be required for Gates breakers which that company has already installed in various plants in California and neighboring States. This will enable the Allis-Chalmers Co. to make immediate shipment of complete crushers required in that part of the country, or in the islands of the Pacific.

—Lawrence Pump & Engine Co., Lawrence, Mass., report the following recent shipments of their improved "Vortex" centrifugal pumps: Standard Oil Co.; American Woolen Co.; Kimberly & Clark Co., Neenah, Wis.; International Paper Co.; F. W. Bird & Son, East Walpole; Bryant

Paper Co., Kalamazoo, Mich.; St. George Pulp & Paper Co., Norwalk, Conn.; Fiberloid Co., Indian Orchard, Mass.; Alkali Rubber Co., Akron; Lawrence Mfg. Co., Lowell, Mass.; M. T. Stevens & Sons Co., North Andover, Mass.; N. E. Cotton Yarn Co., Taunton, Mass., and others.

—Ernst Wiener has severed his relations with the house of Arthur Koppel with whom he has been connected for eighteen years, and has opened offices at 68 Broad Street, New York, under the firm name of Ernst Weiner Co. The new company will make a specialty of railroads and railroad materials for all industries of both narrow and standard gauge. A special factory equipped with all modern machinery has been built in Youngstown, Ohio, for the purpose of exclusively manufacturing the specialties for the new firm. Carl Koch, for many years chief engineer of Arthur Koppel, is associated with Mr. Wiener in his new enterprise.

—A. Allan & Son, New York, have just completed applying Allan metal to the eleven engines at the New York Edison Company's Waterside station. These engines, which are Westinghouse vertical 8,000-horse power engines, have two low pressure and one high pressure cylinder, 76 inches and 44 inches respectively, making thirty-three pistons to which they have applied their metal in this station. There are three rings of Allan metal 1⅞ inches wide and one ring ⅞ inch wide applied to each low pressure piston and three rings 2 inches wide and one ring 1⅛ inches wide applied to each high pressure piston. It required to babbitt the 33 pistons 17,270 pounds of Allan metal.

—Robins Conveying Belt Co., New York, has closed the following contracts: Haverhill Electric Co., Haverhill, Mass. coal conveyors and elevators; Arlington Mills Co., Lawrence, Mass., coal handling machinery for the boiler house; New Jersey Zinc Co., belt conveyors for their plant at Palmerton; Union Fuel Co., San Francisco, conveyor and elevator; Orlando Water & Light Co., Orlando, Fla., belt conveyor for handling wet muck; C. W. Hunt Co., West New Brighton, N. Y., a conveyor; and Semet Solvay Co., Milwaukee, five belt conveyors for their crushing plant. The storing and reclaiming bridge which they are erecting at Milwaukee for the last named company is now in operation. They have also completed several large export shipments for Germany, South Africa and Belgium.

—The Panama commission has purchased several of the Palmer automatic machines from the Harmon S. Palmer Co., Washington. These machines are to be used in the manufacture of blocks for the various buildings required by the officials and employees at Panama City and other points. J. D. Wood, who has wide experience in the manufacture of concrete building blocks, has been employed by the government to install the necessary plant and superintend the manufacture of blocks and the construction of buildings so far as the concrete blocks are concerned. Mr. Wood states that the new Palmer automatic is a great stride forward in the construction of concrete block machines. There is no question but that hollow concrete building blocks are admirably suited to tropics and that their use by the government will serve to introduce them into general use.

—The Degnon Contracting Co., contractors for the two new tunnels under the East River between New York and Long Island City, have just placed one of the largest machinery orders of recent times with the Ingersoll-Sergeant Drill Co., New York. This order includes fourteen air compressors, of two different types. Eight are of duplex compound class "HC" pattern with steam cylinders 16 and 28 inches in diameter, air cylinders 25¼ and 16¼ inches in diameter, and a stroke 16 inches. Each unit has a free air capacity or 1,205 cubic feet per minute. The other six are of straight line class "A" type, with a 24-inch steam cylinder, 26¼-inch air cylinder and a stroke of 30 inches. The capacity of each is 1,444 cubic feet per minute. The aggregate free air capacity of 1,205 cubic feet per minute. The cubic feet per minute. This last order makes a total of 54 Ingersoll-Sergeant air compressors in use or contracted for on subsequent tunnels entering New York City. The aggregate free air capacity of these machines is 138,426 cubic feet per minute, and the pressures delivered range 30 to 150 pounds.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Belting.

AMERICAN WOVEN LEATHER BELTING CO., Springfield, Mass.—Booklet giving a general description of their belting. Illustrated with many fine half-tones. It also contains numerous testimonial letters. 6 by 9 in.; pp. 32.

Boilers.

PARKER BOILER CO., Philadelphia.—Catalogue describing the advantages of the Parker boiler. A chapter is devoted to the subject of scale. Contains illustrations showing not only the boiler itself, but also views of many recent installations. Well-printed. 6 by 9 in.; pp. 38.

Box-Car Loaders.

CHRISTY BOX CAR LOADER CO., Des Moines, Ia.—Catalogue illustrating and describing the Christy box-car loaders for loading any size of bituminous or anthracite coal, ore or other minerals into box or stock cars. Also contains views of several recent installations. 7 by 9½ in.; pp. 42.

Condensers.

WILLIAMSON BROS. CO., Philadelphia.—Well-printed catalogue entitled "A Condensed Talk About Condensers," containing an illustrated description of the different types of condensers manufactured by them. Cooling towers, evaporators and feed water heaters are also treated. 6 by 9 in.; pp. 32.

Controllers.

WARD LEONARD ELECTRIC CO., Bronxville, N. Y.—Leaflets showing the application of the Ward Leonard machine tool controller to a 21-in. slotter and to a two-piece crank shaper.

Conveying Machinery.

ROBINS CONVEYING BELT CO., New York.—Bulletin No. 12, illustrating and describing hoisting and conveying machinery for power stations. Contains illustrations showing some recent installations. 6 by 9 in.; pp. 16.

Dump Cars.

KILGORE-PETELER CO., Minneapolis.—Catalogue No. 3 treating of the different styles of dump cars manufactured by them and the uses to which they may be adapted. Contains numerous illustrations. 9 by 6 in.; pp. 32.

Engines.

BALL ENGINE CO., Erie, Pa.—Catalogue O presenting entirely new designs of both horizontal and vertical engines. Is well printed and contains many fine illustrations. 9 by 12 in.; pp. 32.

Feed Water Heater.

NATIONAL STEAM SPECIALTY CO., St. Louis.—Catalogue illustrating and describing the Kellar combined feed water heater and purifier. Contains numerous testimonial letters, together with a list showing the different sizes in which the heater is built. 7½ by 9 in.; pp. 32.

Gas Blast Furnaces.

CHICAGO FLEXIBLE SHAFT CO., Chicago.—Catalogue illustrating and describing a few of the great variety of purposes for which the Stewart gas furnaces are especially adapted. Automatic heating machines, rotary pressure blowers and flexible shaft machinery are also illustrated and described. 6 by 9 in.; pp. 50.

Gas Engines.

DE LA VERGNE MACHINE CO., New York.—A well-printed catalogue describing the design and operation of the Koerting two-cycle gas engine. This description supplemented by the numerous engravings and sectional cuts gives a general idea of the working of the engine. Also contains tables giving much valuable data. 10½ by 7½ in.; pp. 54.

Hoisting Engines.

ALLIS-CHALMERS CO., Milwaukee.—Catalogue No. 126 deals with hoisting engines and accessories and contains much valuable data on this subject. Catalogue No. 122 treats of smelting furnaces, and Bulletins No. 1600 and 1601 are devoted to a description of 30,000,000 gallon pumping engine installed in Chestnut Hill High Service Station of the Metropolitan Water Works, Boston, and the 15,000,000 gallon vertical triple expansion pumping engine installed in the Baden High Service Station of the St. Louis Water Works, respectively. All of the above publications are well printed and finely illustrated.

Locomotives.

BALDWIN LOCOMOTIVE WORKS, Philadelphia.—Bulletins Nos. 51, 52 and 53. Nos. 51 and 53 contain notes on the principles and performances of the balanced compound locomotives, and No. 52 a record of the recent construction of forged and rolled steel wheels. All three are printed in two colors and well illustrated. 9 by 6 in.; pp. 42.

Metal.

A. ALLAN & SONS, New York.—Catalogue illustrating and describing Allan's anti-friction metal, metallic gasket metal and metal valve discs. Also contains numerous testimonial letters from users. 8 by 5 in.; pp. 56.

Minting Machinery.

E. W. BLISS CO., Brooklyn.—A very neat and attractive catalogue illustrating and describing special mint machinery for making coins of all

denominations. The press-work is well executed. 5 by 7¼ in.; pp. 40.

Motors.

SPRAGUE ELECTRIC CO., New York.—Bulletin No. 223 containing an illustrated description of type N motors specially designed for crane service. 8 by 10½ in.; pp. 12.

BARRIETT ELECTRIC CO., Cincinnati.—Bulletin No. 4 illustrating and describing the Barriett motors, together with an illustrated description of the different parts. 7 by 10 in.; pp. 24.

Pipe Joints.

CRANE CO., Chicago.—Two circulars, one illustrating and describing their extra heavy flanged pipe joints with swivel flanges suitable for working pressures up to 250 pounds, and the other their flanged pipe joints with wrought steel flanges welded on suitable for working pressures up to 250 pounds. 6½ by 10 in.

Planing Machines.

NEWTON MACHINE TOOLS WORKS, Philadelphia.—Catalogue No. 41 illustrating and describing a number of rotary planing machines that are made of one general design in varying sizes. A table of dimensions is also given. 6 by 9 in.; pp. 24.

Power Transmission.

DODGE MANUFACTURING CO., Mishawaka, Ind.—Catalogue C-7 containing up-to-date and dependable information on the subject of power transmission equipment. The American system of rope transmission is entered into and exploited very thoroughly. Is profusely illustrated and contains many tables giving much reliable data. 6 by 9 in.; pp. 416.

Pumps.

LAWRENCE PUMP & ENGINE CO., Lawrence, Mass.—Catalogue A1 containing an illustrated description of the "Vortex" centrifugal pumps. Also contains tables giving sizes, capacities and prices. 6 by 3½ in.; pp. 32.

GOULDS MANUFACTURING CO., Seneca Falls, N. Y.—Catalogue devoted to describing and illustrating their power pumps for every service, giving specifications, prices, etc., of the different styles manufactured. Also contains much useful information on water, belting, friction in water pipes, etc. 8 by 7 in.; pp. 192.

Separators.

WARREN WEBSTER & CO., Camden, N. J.—Leaflet briefly describing Webster steam and oil separators. Illustrated. 3 by 6 in.

Steel.

CARPENTER STEEL CO., New York.—Booklet describing the different grades of steel and the uses to which they are adaptable. Also contains many tables and other useful memoranda. 4 by 6½ in.; pp. 60.

WILLIAM JESSOP & SONS, LTD., New York.—"Jessop's Steel and How They Make It," is the title of a well-printed catalogue containing an exhaustive treatise on this subject. The numerous illustrations show the different processes in the art of steel making. 9 by 6 in.; pp. 74.

Steel Ceilings.

AMERICAN METAL STAMPING CO., Philadelphia.—Bulletin on the subject of the new light balancing selective diffuser ceilings which are being installed in connection with the arc lamps of the General Electric Co. Also contains a treatise on the subject of color and distribution of artificial lights. The bulletin is well printed and contains many fine illustrations. 9 by 12 in.; pp. 44.

Taps and Dies.

BAY STATE TAP & DIE CO., Mansfield, O.—Catalogue containing a brief description of the many different sizes and styles of taps and dies manufactured by this company, together with a list of prices. Screw plates and twist drills are also treated. 6 by 9 in.; pp. 56.

Track Laying.

INGERSOLL-SERGEANT DRILL CO., New York.—Bulletin No. 2002 entitled "Track Laying on the Williamsburg Bridge," issued by the pneumatic tool department, giving a brief description of track work. It also contains some interesting facts concerning the costs and materials for the bridge. 6 by 9 in.; pp. 16.

Transformers.

WAGNER ELECTRIC MFG. CO., St. Louis.—Bulletin No. 72 describing the construction and operation of their "two in one lighting and motor transformers." Illustrated. 6 by 9 in.; pp. 10.

Traveling Hoists.

NILES-BEMENT-POND CO., New York.—Pamphlet containing a brief illustrated description of the Niles electric traveling hoists. Electric traveling trolleys are also treated, and the pamphlet contains many illustrations showing recent installations of both the hoists and trolleys. 12 by 9 in.; pp. 24.

Vises.

FULTON MACHINE & VISE CO., Lowville, N. Y.—Catalogue containing an illustrated description, together with prices and sizes, of their patented vises adapted to machinists, locomotive works, structural iron-builders, jewelers and mechanics generally. 3½ by 6 in.; pp. 16.

Water Purification.

AMERICAN STEEL & WIRE CO., Chicago.—A treatise on the use of sulphate of iron and copper in water purification. Contains reports of the United States government experts on experiments conducted at Anderson, Ind., in February, 1905. 5½ by 8 in.; pp. 20.

Wind Mills.

FLINT & WALLING MANUFACTURING CO., Kendallville, Ind.—Catalogue No. 46 illustrating and describing the Star wind mills and the uses to which they are adaptable. Tanks are also treated. 5 by 9 in.; pp. 64.

IMPROVED MACHINERY

New Processes and Appliances

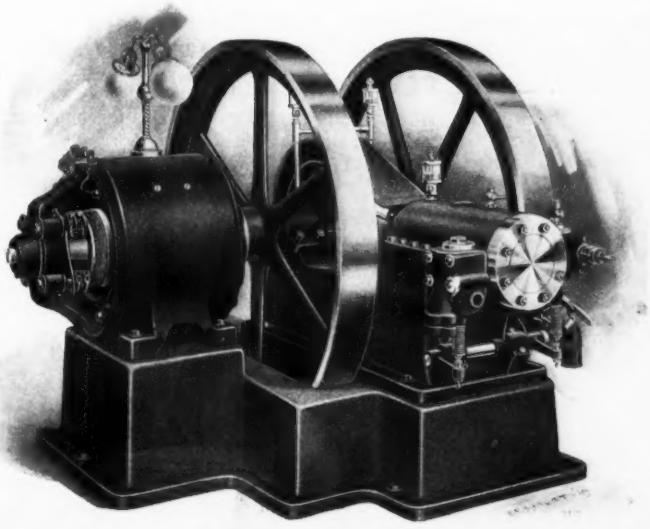
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Direct Connected Gas Engine.

THE operation of dynamos, especially when direct connected, is, of course, one of the most difficult services to which gas engines are applied. Few single cylinder direct connected outfits have been put out, but we illustrate a unit constructed by the Foos Gas Engine Co., Springfield, Ohio, with which the results achieved were unusually good, the variation in speed between no load and full load being within one per cent.

The "Special Electric" type of Foos engine is very largely sold for store and factory lighting and is especially adapted to isolated residence plants. The majority of these installations use belt driven dynamos, the belt being carried by the large crown faced flywheels, and the regulation is such as to produce a light in which no variation is noticeable, and which really excels the results with many steam plants. This is achieved without counterbalancing the armature, as is customary with most gas engine installations. Any ordinary gasoline, distillate, or gas can be used and with the latter fuel, throttling governors are usually applied.

The wipe spark system of ignition as employed in the Foos engine makes positive ignition certain and adds greatly to the efficiency and reliability of the engine, this being especially necessary in electrical installations. Smooth running is insured



FOOS DIRECT-CONNECTED GAS ENGINE.

by solidly bolting the counterbalancing weights, which are in the form of discs, to the arms of the crank and thus concentrating the weight between the bearings and in direct line with the parts to be balanced, rather than the usual arrangement of casting weights in the flywheels. This method of counterbalancing also relieves the bearings and crank shaft of considerable strain and thus prolongs their life materially. The positive action of the valves and their vertical position—which prevents side wear and deterioration of the valve seats as well as the manner in which they are surrounded by water jacket, assist also in making the engine extremely reliable.

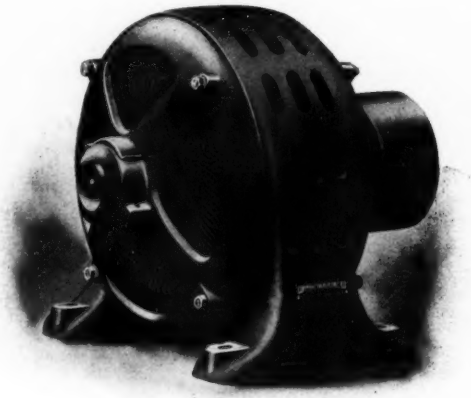
One of the features of this engine, which would appeal to purchasers, is its extreme accessibility and the ease with which any part can be inspected or removed without disturbing any other feature of the engine, or any of its pipe or other connections. Either valve, either portion of the igniter, the cylinder head, piston, rings, etc., can each be handled as suggested, independently, and without interfering with any other part of the engine—an advantage which is not found so highly developed in any other engine with which we are acquainted.

The Foos Gas Engine Co., Springfield, Ohio, is very willing to furnish information relative to this "Special Electric," or the other engines which they manufacture.

Induction Motors for Constant Speed.

ON account of their simplicity, their avoidance of sliding contacts, their operation with alternating currents, which are now used in practically all high-voltage electric transmissions, and of various other advantages, induction motors have been increasingly used during recent years, and have been applied to many services where direct-current motors alone were formerly employed.

They have been more generally used in Europe than in this country and their development abroad has, perhaps, reached a more advanced position than it has here, so that the Commercial Electric Company, in deciding to make a new departure from their established practice—the manufacture of direct current machinery—and place a line of induction motors upon the market, were well advised in securing the services of an eminent European electrical engineer for designing their new product. In this way they succeeded in eliminating the experimental stages through which most factories have to pass when making a new class of machinery.



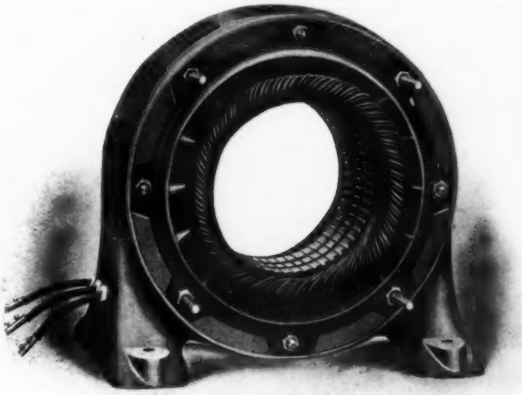
COMMERCIAL ELECTRIC COMPANY INDUCTION MOTOR.

These machines are constructed in two different classes for constant speed work, the selection of the class depending upon the nature of the work to be performed. In the summary of the advantageous points possessed by these machines given below, only the points of paramount importance to the user or purchaser of the apparatus are mentioned.

In order to produce a high power factor in these machines, it is essential that they have a limited clearance between the external diameter of the rotor and the internal diameter of the stator. The design of the stator frame and stator head are such that an equal division of this clearance is always secured and maintained, it being

impossible to assemble the machine in such manner as to give the rotor an unequal air gap on opposite sides. In order to reduce the wear of the rotor shaft to a minimum, very large bearing surfaces have been provided.

Special attention may be called to the following points which are obtained in these machines: high power factor; large nominal break down factor; high efficiency at both heavy and light loads; low working temperatures; small idle currents; high starting torques.



COMMERCIAL ELECTRIC INDUCTION MOTOR.

The bearings are self-oiling and self-aligning and are arranged so that the machines can be conveniently inverted, when location renders it desirable. The bearings are so designed that if the operator should flood them with oil no damage to the machine could possibly occur. The bearings will be made dust-proof where desired. The linings to the bearings are duplicate and interchangeable, so that the replacement of the bearing is a more simple and less expensive matter than is the accurate readjustment of the so-called "adjustable" bearings.

The shafts are of crucible steel; are of large diameter and the distance between bearings is reduced to a minimum so that they are very rigid and are not easily sprung. All shafts are accurately ground to gauge and the bearings are carefully polished. The rotors are mounted on the shaft with hydraulic pressure. Ventilating apertures are provided across the faces of the stator and rotor cores so that the freest circulation of air is secured, thereby insuring cool operation.

Particular care has been given to the starting devices used in connection with these machines, so that the starting current is reduced to practically that used in the direct-current motors of corresponding capacities.

Unless otherwise specified, paper pulleys will be used on these machines, as has been the practice in Commercial Electric direct-current apparatus.

The type of motors illustrated and described herein is manufactured in all standard capacities, from 5 H. P. to 200 H. P. inclusive. If motors of smaller than 5 H. P. capacity are required, a request for the Company's circular No. 201 should be made. This latter circular describes the line of single-phase, self-starting, induction motors, which are made in capacities from 1 H. P. to 5 H. P.

This style machine is the acme of simplicity, as will be noted by referring to the illustration of the machine disassembled. The terminals of the machine are flexible cables brought through porcelain bushings in the stator frame.

Figure 328 illustrates the motor without the skids, which is preferred in many cases.

The classes of machines illustrated and described herein are made in all standard sizes, voltages and frequencies and in both two and three phases, in 25 and 60 cycles (3,000 and 7,200 alternations).

Tandem Cylinder Crosshead Gas Engine

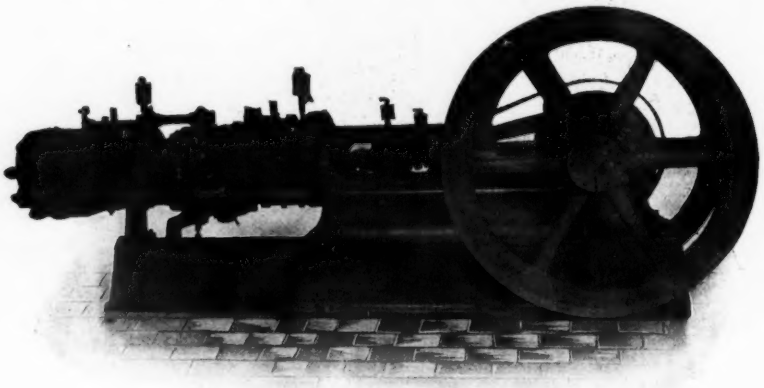
THIS engine has been recently designed and placed on the market by the Ajax Iron Works, Corry, Pa., to meet the re-

quirements of those needing greater power and closer regulation than is furnished in the standard single cylinder gas engines. It is of the same general four-cycle type as the other engines of this company, except that in this the explosions occur alternately in each cylinder, thus giving an impulse at each revolution, making it a very smooth running gas engine, and capable of very close speed regulation. The use of the crosshead has been found to give excellent results by avoiding all the thrust on the piston and cylinder walls, caused by the angularity of the connecting rod in the trunk piston engine. The crosshead has adjustable shoes with ample bearing surfaces. It is thoroughly lubricated, the bottom shoe running in oil, and is not liable to excessive wear. The cylinders are made of a special mixture of dense, close iron, and are subject to very little wear.

A feature of interest to users of gas engines is the arrangement of the water circulation, it being so constructed that the water never comes in contact with the gaskets, and they cannot become water-soaked. This greatly reduces the liability of gaskets blowing out, and if they should do so the water cannot get into the cylinder or mixing valve.

The valves are mechanically operated. The combination intake and mixing valves are both contained in a removable valve chest. They also have removable seats which can be taken out and replaced by simply unscrewing the two plugs over the valves. The gas valve, or governor valve, is attached to the outside of the main valve chamber, and is handled by the governor admitting gas as the load requires it. The governor is very sensitive and easy of adjustment, the speed being changed by turning a right and left hand nut.

The engine is very heavy in all its parts, and is mounted on a substantial sub-base, insuring complete alignment of all parts and perfect rigidity. The working parts are all open to view and easily reached. They run equally well with natural or manufactured gas or gasoline. An air-starting device of approved design is part of the equipment of this type of engine.



TANDEM CYLINDER CROSSHEAD GAS ENGINE.

Cameron Pumps for Ice Making.

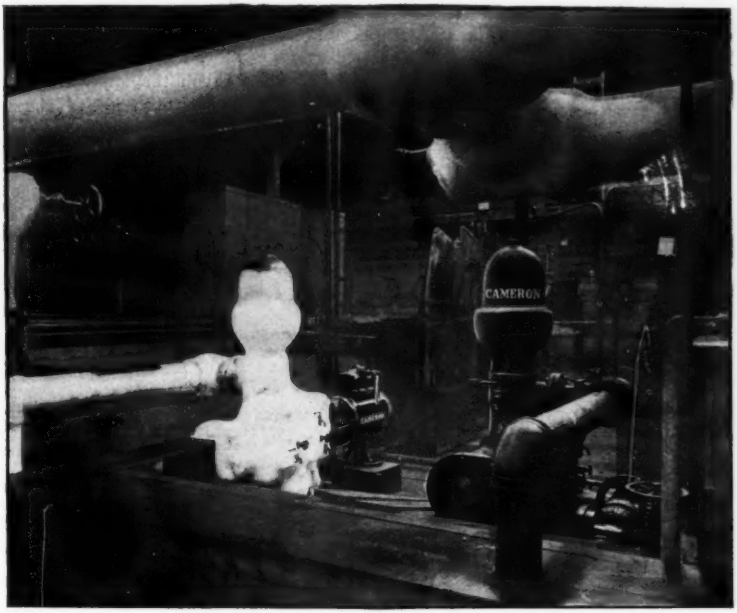
PERHAPS one of the most severe tests of pumping machinery was made by the Ice and Cold Machine Co., at the ice making and refrigerating plant, Louisiana Purchase Exposition, St. Louis, during the entire period of the Fair. The photographic view shows two 10 x 9 x 18 Cameron special brine circulating pumps, of the light service pattern, having long bodies and composition linings, which were in operation and were used alternately in the refrigerating pipe line, which was claimed to be the longest continuous line in operation

using brine as a refrigerating agent. These pumps were in constant use day and night during the entire time of operation of the 500-ton refrigerating machine (May 14th to December 3d), with the two ice tanks capable of making 120 tons of ice daily, and cold storage space of 100,000 cubic feet.

Brine at a temperature of 10 degrees above zero was put into the pipe line and pumped through the numerous refrigerator boxes, containing 60,000 cubic feet, at the German Tyrolean Alps, 7,000 feet distant from the plant; the brine traveling through the pipe a distance of over 14,000 feet after leaving the pumps, before returning to the brine coolers.

These pumps required but little attention and withstood the constant rack and severe strains to which they were subjected. Having automatic governors, they maintained continuously a constant pressure in the service pipe line, thereby making a uniform and regular feed to every refrigerating coil connected to the line; and they were so designed and constructed as to permit of the instantaneous opening of any of the large valves without detriment to the steam or brine cylinder heads.

The pipe line was used by others for refrigerating between the above mentioned points, but the connections and arrangement were such that no difficulty was experienced in getting proper circulation and without interfering with other boxes on the line. Adverse circumstances were experienced in putting in the line, owing to its location and the weather conditions. Sewers, electric conduits, water, gas and fire line service pipes, had to be crossed over or under, or the line laid parallel with them in many places; to say nothing of having swampy grounds, railroad crossings, the "River des Pères" and minor difficulties to contend with.



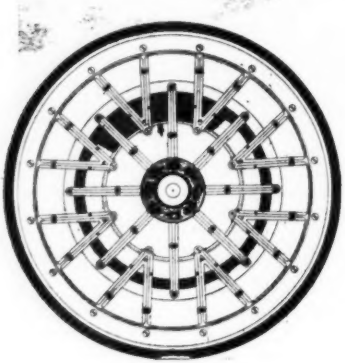
CAMERON PUMPS IN A REFRIGERATING PLANT.

A New Pneumatic Wheel.

THE automobile industry has been bounding forward with such rapid strides that it now easily holds the center of the stage in point of popular mechanical interest. Indeed, among technical readers

who look back for only five years, the advances achieved in the mechanical construction and operation of these road machines, give ample warrant for the widespread popular interest which the science holds to-day.

Meanwhile, as the very basis of this astonishing and gratifying mechanical advance, the pneumatic wheel—as first demonstrated in the bicycle and now further demonstrated in the automobile—holds undisputed rank as the one device affording the greatest measure of comfort and the highest rate of speed ever yet attained in roadway or ground traction. An insuperable objection to the pneumatic tire, however, is its liability to puncture, its skidding propensities, and the fatality to life, comfort and pleasure which must ever attend a pneumatic cushion running on surfaces which present innumerable opportunities for puncture, explosion, and disaster.

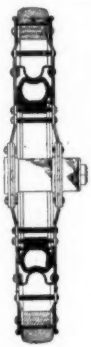


Herewith we present diagrams of a recently invented pneumatic wheel which completely obviates the possibility of surface punctures, while at the same time affording greater resiliency, equal or greater speed, and certainly a wheel-tread which can go anywhere that road vehicles travel.

Readers who are familiar with mechanical construction will at once see that this is, in reality, "a wheel within a wheel"—the outer tire being of iron or hard rubber, as may be desired, and the pneumatic tube being securely encased within the wheel, 8 or 9 inches above the tire or surface tread. Describing the construction, the inventor, Mr. John C. Rutherford, says: "As the weight of the vehicle rests absolutely on an air cushion, the advantages indicated are secured without sacrificing in the smallest degree the resiliency, which is the one great advantage of the pneumatic tire as at present used.

"If, going at the highest rate of speed, the pneumatic tube of the iron tire wheel should collapse, there would only result a slackening of speed. *The wheel does not change its diameter or shape,* and, consequently there is no tendency to swerve from the straight line, a most important point, as many fatal accidents have proved.

"The weight of the car is suspended and distributed through the upper half of the wheel, and is in front of, and above the center. This is true because the hub moves out of center to the extent that the pneumatic tube is compressed by the traction of the machine—so that the weight of the car really assists in maintaining the momentum, so long as the power is applied.



"The great strength and rigidity of this wheel is due to the fact that it is built with a three-point suspension, or triple arch. There are 48 steel spokes, each having a tensile strength sufficient to carry the weight of the car."

For delivery wagons, freight trucks, and large sight-seeing automobiles, as well as for long-distance touring cars traveling over country roads and turnpikes, the oval iron tire, to run on the surface, is of course preferable, because it is practically indestructible and absolutely safe. But for pleasure vehicles, to be run on city streets and through park driveways, under conditions where noiselessness and comfort are the main considerations, a hard rubber tire—similar to those used on rubber-tired carriages—is substituted for the oval iron tire.

By reason of the many advantages which the wheels have already demonstrated in practical use, we take pleasure in commending the invention to the consideration of those of our readers who may be concerned in the development of the automobile industry. For further particulars, address the Iron Tired Pneumatic Wheel Company, 259 Fifth avenue, New York, U. S. A.

NEWS SUPPLEMENT

The Engineering Magazine—November, 1905.

Personal.

—J. F. Witmer will assume charge of special work for J. G. White & Co., New York, bearing on hydraulic engineering.

—O. A. Stranahan, formerly manager of the power department of the Allis-Chalmers Co., has been promoted to the position of sales manager, with headquarters at Milwaukee. M. C. Miller will be his assistant.

—Joseph C. Russell, formerly connected with the Pittsburg office of the Burroughs Adding Machine Co., has been appointed manager of the West Virginia office of the same company, with headquarters in the Union Trust Building, Parkersburg.

—Robert McF. Doble, consulting engineer of the Abner Doble Co., San Francisco, has returned from a trip of several months through the Sierra Madre Mountains on the west coast of Mexico and also in Colorado, where he was engaged in making examinations of several important hydro-electric long-distance power projects.

—William F. Wagner, general manager of Wm. Jessop & Sons, Ltd., in the United States, together with Edward L. Hand, who represents them in Philadelphia; E. W. Salisbury, of Warren Salisbury & Nightingale, their agents in Providence; E. D. Ridgley, their representative in Detroit, together with F. W. Babcock, of the Standard Oil Co., will attend the 282nd annual gathering of the Cutlers Co., at their banquet in Sheffield. On this occasion Sydney Jessop Robinson, managing director of Wm. Jessop & Sons, Ltd., will be installed as Master Cutler—a position of great honor and of social and commercial influence.

Industrial Notes.

—The Erie Railroad is installing roundhouse heating systems furnished by the B. F. Sturtevant Co., Boston, for its houses at Salamanca, N. Y.; Port Jervis, N. Y.; Meadville, Pa.; and Cleveland.

—American Car & Foundry Co. have recently added to their equipment at the Madison Plant, Granite City, for the construction of steel and composite cars, 100 Boyer long stroke riveting hammers, manufactured by the Chicago Pneumatic Tool Co., Chicago.

—The Reeves Engine Co., New York, through their Chicago manager, Joseph B. Hall, have arranged with the Dwyer Plumbing and Heating Co., St. Paul, to handle the territory tributary to St. Paul. F. J. Spriggs, M. E., will be in charge of engineering matters for the Dwyer Co.

—The Wile Power Gas Co., Rochester, manufacturers of gas producers for power and fuel installations, are now erecting, for the American Graphophone Co., Bridgeport, a large producer gas fuel plant to take the place of illuminating gas which they are now using.

—The Tuscaloosa Mills, Tuscaloosa, Ala., containing nearly three-quarters of a million cubic feet of space, are to be heated and ventilated by the Sturtevant system. A complete exhaust system for napping machines and another for the slashers, together with a coke cooling equipment, are being installed by B. F. Sturtevant Co., Boston.

—Among recent sales of mechanical draft equipment made by the B. F. Sturtevant Co., Boston, are those for the boiler plant of the Baltimore & Ohio R. R. Co., Chillicothe, Ohio; Chesebrough Mfg. Co., Perth Amboy, N. J.; Hillside Coal & Iron Co., Mayfield, Pa.; Castle Realty Co., New York; Diamond Ice Co., Wilmington, Del.; Athens Waterworks, Athens, Ohio; St. Paul Gas Light Co., St. Paul.

—The Robins Conveying Belt Co., New York, has recently secured through J. G. White & Co., New York, the contract for the belt conveyors for the U. S. Naval Coaling Station at Olongapo, Philippine Islands. They are also constructing a belt

conveyor for handling coal for the Lackawanna Steel Co.'s plant at Buffalo, and expect to ship shortly a large order of belt conveyors for the Santanda Iron Mines, Santanda, Spain.

—The Ingersoll-Rand Co., New York, announces the establishment of a branch office at Houghton, Mich., under the management of T. F. Lynch, who has for several years past represented the Ingersoll-Sergeant Drill Co. in the copper and iron districts of the North. At the new office a complete stock of repair and duplicate parts for all Ingersoll-Rand machinery will be carried.

—The Lawrence Pump & Engine Co., Lawrence, Mass., have been awarded the contract for a centrifugal pump and engine to be installed for the city of Washington, Ind. The pump will have a capacity of three million gallons per day and will be of the makers' latest design, driven by a vertical fully enclosed engine, arranged for forced lubrication. In addition to the main pumps and engines the contract includes the smaller centrifugal pumps for use in connection with other apparatus in the plant.

—The New Process Raw Hide Co., Syracuse, N. Y., has announced its intention of going more extensively into the manufacture of metal gears of all kinds as well as its well-known New Process noiseless pinions. In furtherance of this plan the company has just completed a two-story brick addition containing about 10,000 feet of floor space and is installing a number of additional turret lathes, drills, grinders, spur gear cutters, bevel gear planers and other machines necessary for the manufacture of accurate gearing. This additional equipment will increase the company's capacity about 75 per cent.

—The Alberger Condenser Co., New York and Chicago, announce that they have recently acquired the entire Wainwright business, and will hereafter manufacture and sell the well known Wainwright feed water heaters and expansion joints. These specialties have lately been manufactured by the Taunton Locomotive Manufacturing Co., Taunton, Mass., who are now going out of business. William R. Billings, formerly treasurer and general manager of that company, has become connected with the Alberger Condenser Co. and will be in charge of the Wainwright business under its new ownership.

—The various stations and shops of the Philadelphia Rapid Transit Co. furnish an interesting exhibit of the variety in products manufactured by the B. F. Sturtevant Co., Boston, for the equipment of plants of this class. In the various sub-stations are no less than ten steel plate fans especially designed for cooling transformers. In one of its shops is a complete heating and ventilating system consisting of fan, heater and distributing pipe. In another is a forge shop equipment, together with an exhauster for removing smoke, while a large cupola furnace is supplied with a Sturtevant pressure blower.

—In its investigation of the natural resources along The Northwestern Line the Industrial Department of that company has had its attention called to a situation at a northern Nebraska point that in a way indicates what the future of this country may provide to the industrial world. The point referred to is a city having a population of about 1,200 people located on one of the great rivers of the State. This river affords at this location a very desirable water power site with capacity estimated at 4,000 h. p. This power could be used in many ways to great advantage. It would be especially valuable for the generation of electric power that could be turned to manufacturing purposes. As, for instance, if the splendid deposits of glass sand that are found close by, and which by analysis show 98 per cent. silica, could be used for the manufacture of glass products by an electric process, the current generated by water power, an opportunity would seem to be available. With reference to the manufacture of glass by the electric arc, a description of a German process shows that it is possible to reduce the capital necessary for the erection of a plant, giving a simpler, cleaner and quicker process and a considerable saving of heat, energy, and a pure product. The workmen are not subject to the continual heat and it is not necessary to continue the work during the night as with the ordinary coal or gas methods, as the work may be interrupted at any time without incurring such enormous losses of heat.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

LAIDLAW-DUNN-GORDON CO., New York.—Bulletin L 508, describing the improved Cincinnati air compressor. The adaptations of this compressor to different methods of driving and to different types of steam ends are shown in the numerous illustrations. 6 by 9 in.; pp. 32.

Boilers.

PHILADELPHIA IRON WORKS, Philadelphia.—Catalogue illustrating and describing their horizontal, vertical and internal fired boilers, together with specifications. Receiving and storage tanks, vertical and horizontal air receivers, vertical and horizontal hot water generators, steel stacks, steel chimneys, stand pipes, tower tanks, and water towers are also treated. Also contains numerous tables giving much valuable information. 5 by 7 in.; pp. 42.

Cement.

ILLINOIS STEEL CO., Chicago.—Catalogue issued by their cement department containing the results of tests made of Universal Portland cement. Also contains illustrations showing buildings on which their cement was used, together with many testimonial letters. 6 by 9 in.; pp. 64.

Coal Mining Machinery.

INGERSOLL-SERGEANT DRILL CO., New York.—Pamphlet illustrating and describing their coal cutters and coal boring machines. Hammer drills, rock drills, and air compressors are also treated. 5 by 3 in.; pp. 16.

Conveying Machinery.

BROWN HOISTING MACHINERY CO., Cleveland.—Well printed catalogue bound in cloth illustrating and describing the latest machines of the Brown type for unloading coal or iron from boats and delivering it either into railroad cars or on stock piles, and vice versa, and for the hoisting and conveying of general merchandise at docks, steel works, and blast furnaces; also for the handling of material during the construction of ships at ship yards. Also treats of their furnace hoist and stock distributor for the charging of blast furnaces; besides many other plants for the handling of material in the yards of steel works, structural shops, etc. The Brownhoist suspended pocket is also given a place; this construction being used in connection with the charging larries in many of the largest steel works. 12 by 9 in.; pp. 200.

Diamond Drills.

SULLIVAN MACHINERY CO., Chicago.—Catalogue No. 49 treats of the general features of the Sullivan diamond prospecting core drill, together with tables showing capacities, prices and weights. Also contains numerous testimonial letters. 6 by 9 in.; pp. 152.

Dump Wagons.

TROY WAGON WORKS CO., Troy, Ohio.—Booklet illustrating the different styles of dump wagons manufactured, together with a table giving sizes. 6½ by 3½ in.; pp. 8.

Electrical Equipment.

GENERAL ELECTRIC CO., Schenectady, N. Y.—Bulletins Nos. 4417 to 4420 inclusive, illustrating and describing generating station and substation switchboards, the synchronism indicator, high candle-power incandescent units, and Thomson high torque induction test meter. Also pamphlet entitled "Electricity versus Steam for Train Haulage."

Industrial Engineering.

INDUSTRIAL ENGINEERING CO. OF AMERICA, New York.—Pamphlet giving in concise form the style of work undertaken by this company, which consists of the designing of new machinery, superintending the erection of new buildings, etc. Also contains a list of the concerns for whom they have recently done such work. 9 by 6 in.; pp. 24.

Lathes.

GISHOLT MACHINE CO., Madison, Wis.—Catalogue J-4 printed in two colors illustrating and describing the different styles of lathes manufactured. Vertical and horizontal boring and turning mills, tool grinders and turret tool posts are also treated. 8 by 10 in.; pp. 40.

Machine Tools.

BLAKE & JOHNSON, Waterbury, Conn.—Catalogue illustrating and describing the full line of milling machinery, presses, grinders, rivet machines, wire nail machines, thread rolling machines, etc., manufactured by this company, together with tables giving dimensions, prices, weights, etc. 6¾ by 9 in.; pp. 80.

Milling Machines.

CINCINNATI MILLING MACHINE CO., Cincinnati.—Catalogue containing an illustrated description of the various styles of milling machines and attachments manufactured by them. Also contains speed tables for high speed steel cutters that will be found valuable to users of such machines. 6 by 9 in.; pp. 110.

Motor Cars.

THE ADAMS CO., Dubuque, Iowa.—Bulletin No. 5 illustrates and describes the Adams-Farwell motor cars, together with a description of the Chicago-St. Paul tour. 6 by 9 in.; pp. 12.

Motors.

NORTHERN ELECTRICAL MANUFACTURING CO., Madison, Wis.—Bulletin No. 51, containing much helpful information regarding the ratings and dimensions of Northern machines and illustrates some recent applications of heavy motor drives. 6 by 9 in.; pp. 24. Also leaflet No. 145.

devoted to illustrating and describing Northern electric forge blower equipments. Capacities 75 to 425 cubic feet of air per minute.

Office Equipment.

GLOBE-WERNICKE CO., Cincinnati.—Three well-printed catalogues. No. 105, is devoted to "Elastic" bookkcases; No. 805 to office filing cabinets, and No. 905 to filing cabinet supplies; including transfer cases, indexes, record cards, vertical file folders, guides, etc. They also contain tables giving sizes, prices, etc., together with many fine illustrations showing the equipment in use. 6 by 9 in.

Oiling Systems.

PITTSBURGH GAGE & SUPPLY CO., Pittsburgh.—Catalogue illustrating and describing the White Star continuous oiling system. Various types of filters, pumps, storage reservoirs, fixture fittings, etc., are also illustrated and described. 6 by 9 in.; pp. 16.

Pneumatic Tools.

CLEVELAND PNEUMATIC TOOL CO., Cleveland.—A well-printed catalogue containing an illustrated description of their chipping and riveting hammers, drills, hose couplings and other pneumatic appliances. Also contains tables giving sizes, weights, revolutions per minute, etc., of the different tools. 9 by 6 in.; pp. 64.

Portable Tools.

H. B. UNDERWOOD & Co., Philadelphia.—Catalogue bound with a flexible leather cover containing illustrations and descriptions of their portable tools for railway repair shops. 6 by 9 in.; pp. 36.

Pumps.

LAWRENCE MACHINE CO., Lawrence, Mass.—Catalogue illustrating and describing their centrifugal pumps, together with much information of a valuable character and tables giving sizes, capacities, etc. 6 by 9 in.; pp. 48.

THE DEMING CO., Salem, O.—Catalogue G illustrating and describing their triplex power pumps, deep well working heads, etc. Contains many tables giving much valuable data. 9 by 6 in.; pp. 112.

Railway Apparatus.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., Pittsburg.—Catalogue illustrating and describing in a general way the lines of alternating and direct-current motors, as well as their generators for railway work and systems of control for electric railways. It also treats their system of catenary line construction for street railway work. Information covering detail and repair parts of motors and other railway apparatus is embodied in the work. The catalogue was distributed at the convention of the American Railway Association held at Philadelphia. Circulars Nos. 1120 and 1123 deal with railway motors for direct-current service and Westinghouse prepayment wattmeters, respectively.

Slide Rules.

KOLESCH & CO., New York.—Leaflet containing a brief description, with illustrations, of the precision slide rules. Their calculaters and chartometers are also treated.

Steam Hammers.

DAVID BELL ENGINEERING WORKS, Buffalo.—Bulletin 805, describing briefly their steam hammers manufactured in four sizes, together with a table giving sizes and dimensions.

Steam Jet Pumps.

E. W. VANDUZEN CO., Cincinnati.—Catalogue containing information on all points relating to the uses to which their pumps are adapted. Also contains tables giving dimensions, prices, etc. Well illustrated. 4½ by 6½ in.; pp. 32.

Steel-Works Equipment.

THE WELLMAN-SEAVER-MORGAN CO., Cleveland.—A very handsomely illustrated catalogue describing the Wellman open-hearth furnace charging machines and charging boxes, with illustrations showing installations at many important works. The illustrations show the Wellman charging machines of both the "High" and the "Low" types, thus covering all the requirements of modern open-hearth furnaces. There are also illustrated charging and manipulating apparatus for re-heating furnaces for charging ingots, blooms, slabs, etc., in heating furnaces and for withdrawing them, together with a variety of special machines for enabling the greater part of the handling of materials in the manufacture of steel to be mechanically accomplished. As is well known, this firm were the pioneers in the replacement of hand labor by machinery for this important and laborious work, and these valuable labor-saving appliances are in extensive use in all parts of the world. The catalogue gives lists of the great manufacturing establishments in which the appliances are in use, these including all parts of the United States where iron and steel are manufactured, as well as Great Britain, Europe, and Asia. The catalogue is an example of fine printing and engraving, forming another addition to the valuable contributions to technical literature made by this representative firm.

Taps and Dies.

BAY STATE TAP & DIE CO., Mansfield, Mass.—Catalogue containing a brief description of the many different sizes and styles of taps and dies manufactured by this company, together with a list of prices. Screw plates and twist drills are also treated. 6 by 9 in.; pp. 56.

Wood Blocks.

UNITED STATES WOOD PRESERVING CO., New York.—Catalogue describing the advantages of wood blocks as pavement. Contains illustrations showing shop floors, bridges, streets, stables, court yards, ferry boats, etc., paved with wood blocks. Is well printed and finely illustrated. 9 by 6 in.; pp. 32.

Waterproofing.

SICILIAN ASPHALT PAVING CO., New York.—Small pamphlet entitled "Waterproofing—Some Recent Improvements in the Art," containing a description of the Carbon cold waterproofing and the many uses to which it is adaptable. 3½ by 6 in.; pp. 10.

Wood Working Machinery.

LINDERMAN MANUFACTURING CO., INC., Whitehall, Mich.—Catalogue containing an illustrated description of their special wood-working machinery. 9 by 6 in.; pp. 16.

IMPROVED MACHINERY

New Processes and Appliances

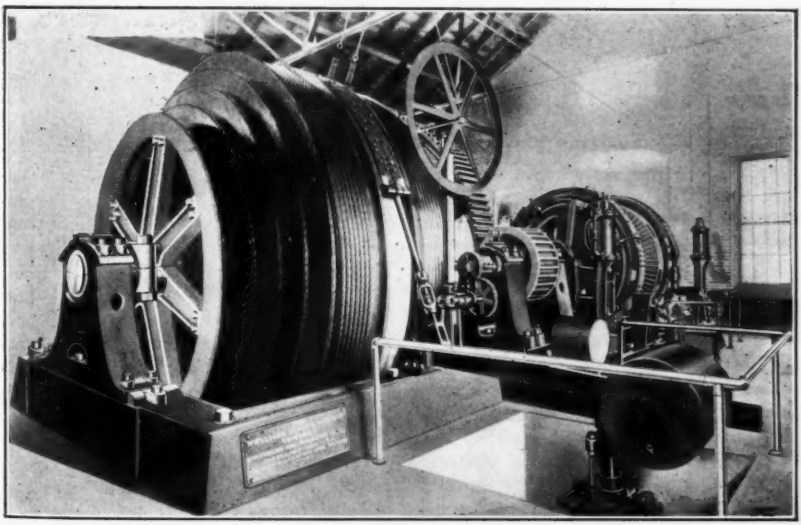
The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A Novel Water Hoist.

THE question of unwatering a mine always is a serious problem to the mine management, especially so when the water is highly impregnated with acids. When the amount becomes excessive the means to be employed for disposing of it taxes the ingenuity of all concerned to the uttermost.

In the anthracite regions there are mines in which for every ton of coal raised, as much as fourteen tons of water must be pumped. Nowhere, probably, have a greater variety of pumps and lifting devices been tried, and the most satisfactory type, up to the present, for handling large quantities of water at comparatively low heads, has proved to be large boilers operated by steam engines. These, however, lack the mechanical regularity inherent in a pump, and it remained for the Delaware, Lackawanna & Western R. R. Co. and its electrical engineer, H. M. Warren, to develop a water-hoisting equipment which would preserve all the valuable points of the steam hoist and at the same time operate automatically. The carrying out of the mechanical details of the hoist and its automatic devices were confided to the Wellman-Seaver-Morgan Company, Cleveland, Ohio. Most of the electrical controlling devices were furnished by the Electric Controller & Supply Company, Cleveland, Ohio.

An accompanying illustration shows a front view of the hoist. As will be noticed the general arrangement consists of a motor driving a pair of bevel wheels through a single bevel pinion. The bevel wheels run loose on a shaft and are fitted with Webster, Camp & Lane friction clutches. The operating mechanisms for the clutches are so designed that only one clutch can be thrown in at a time, but both clutches can



be out at the same time. Throwing in one clutch runs the drum in one direction; throwing in the other clutch reverses the motion of the drum. To the shaft on which the bevel wheels run there is keyed a pinion meshing with main gear on the drum shaft. The drums are of the cylindro-conical type, 10′ at the small diameter and 16′ at the large diameter. At a hoisting speed of 550′ per minute the drum makes about 15 revolutions per minute. There is one main brake located between the drums. All of the clutches and brakes are operated by auxiliary air cylinders fitted with oil cushion cylinders, the compressed air being furnished by a motor driven air compressor and the necessary tanks located near to the hoist. The hoist is controlled by a mechanical device consisting mainly of a drum rotated by means of a friction drive from the motor through a sprocket chain. The drum

shaft transmits its motion to a secondary shaft fitted with variable speed, which in turn operates a secondary stop. The main hoisting drum shaft operates a traveling nut which is so located with respect to the controller drum that at either end of its travel it releases a stop and allows the controller drum to make a quarter turn; this movement, through suitable electrical connections, operates the solenoids on the clutch valve, releasing the clutch and the solenoid on the brake valve setting the brake, the further movement of the controlling drum being arrested by the secondary stop. This stop is released by the variable speed shaft and its connections, which has been given a predetermined time movement corresponding to the interval for emptying the bucket. The further movement of the controlling drum releases the brake and throws in the reversing clutch, thus starting the hoist in the opposite direction, and also starting the traveling nut on the controlling mechanism in the opposite direction. At the end of the hoist the cycle of controlling movements is repeated and so on, making the hoisting operation continuous and automatic. Every attention has been given to the safe operation of the hoist. The main brake is of the gravity type and to be released the current must be on the solenoid operating the valve so that air can be admitted to the underside of the brake piston.

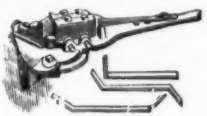
If for any reason, either the supply of current or of air pressure is interrupted, the valve drops, and the weights on brake lever set the brake. The clutches are designed so that they are thrown out by weights. As is the case with the brake, either clutch can only be thrown in when the current is on the solenoid, and the air pressure admitted under the piston, and if either current or pressure fail, the clutch is off. The motor shaft is fitted with an emergency brake operated by a weight controlled by a solenoid—any interruption in the flow of current to the motor sets the brake and stops the motor. Any interruption of the flow of the current stops the machine, throws out the clutches and puts

on the brake. A safety cut-out is provided for in the head frame so that in case a bucket is carried beyond the proper height, the current is cut off.

The head-frame is 93′ from the base to the center of the sheave at the top. It is built of structural steel. From the head-frame are suspended two buckets 6′ in diameter and 19′-6″ deep. The capacity of each bucket is seventeen tons of water. In the bottom of the bucket are located two lift gates with an area practically equal to the cross section of the bucket. These gates are lifted automatically when the bucket reaches the top, and the water is discharged through the bottom into a spout fitted below the bucket, and which deflects it to either side of the shaft. Each bucket makes a complete round-trip in one minute and fifty seconds, the total lift being 555 feet.

Bending Tools.

THE Wallace Supply Company, 901 Garden City Block, Chicago, Ill., are offering the eye and the angle bender, illustrated herewith. The eye bender is made in two sizes, No. 1 taking stock up to and including ½ inch. It bends rings and eyes up to 2¾ inches outside diameter. No. 2 takes stock up to and including ¾ inch; it bends rings and eyes up to 3 inches, outside diameter. The machine bends hot stock and turns out perfect eyes and hooks, uniform in character and size. By the system of gripping the end of the stock and carrying it around, forming a pin, it enables the operator to turn eyes on the ends of long rods.



The angle bender is made in two sizes. No. 1 bends flat stock up to 2 inches wide by ⅜ inch thick, and a round or flat square stock up to ¾ inch. Clean, light corners can be made with this tool. Many light jobs can be bent cold. The No. 2 machine bends flat stock up to 4 inches wide by ½ inch thick, and a round or square stock up to 1 inch. It also bends ⅜x1½-inch stocks, and under, edgewise. It also bends angle iron if a triangular piece of stock is cut from the upper wing. The No. 2 bender takes a wide range of work for a hand machine and will be found valuable in many shops, although for light work the No. 1 machine is more convenient. The angle benders have a wide range of work, for with these machines an operator can bend right, acute, obtruse and bias angles; braces of any angle, stirrups, linings for snap flasks, cranks, staples, yokes, dash board frames, hammer traps, etc. Special dies are made for all kinds of bends.

Both eye and angle benders are so arranged that they can be easily and quickly adjusted to suit the various sizes of stock. To change the size of the eye one removes the pin around which the stock is formed, and a pin is inserted of the size required. The angle bender has movable die blocks to suit the different thickness of material, and also movable stock block and gauge. Both the angle and eye benders are secured removably to brackets which may be fastened to any anvil, forge frame or any other location convenient to the operator.

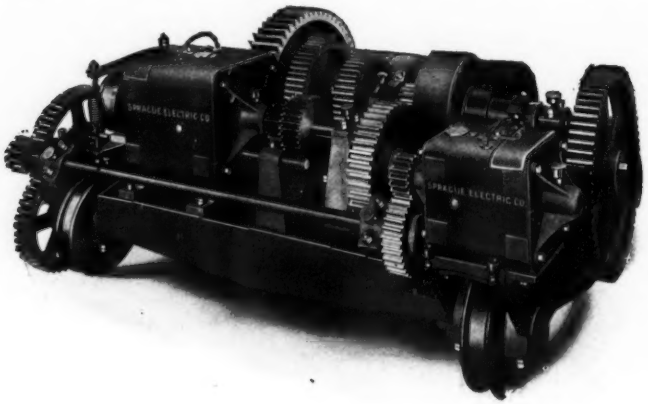
Electric Crane Motors.

ELECTRIC cranes are a most satisfactory means for meeting the requirements, in modern shops, for handling raw material and assembled parts with maximum speed and minimum cost, and, to meet the demand for a strong, reliable and efficient motor for crane service, the Sprague Electric Company has put on the marked their type "N" motors. Crane service requires motors specially adapted to its special line of work, and are more strongly constructed than the ordinary machine tool motor, in order to withstand the unusual strain which crane motors are called on to bear. Care has been taken, therefore, to make these type "N" motors exceptionally strong without being bulky.

The bearings are substantial, easily renewed and inspected, and are thoroughly protected against dirt. The field frames are rectangular in form and include a set of four bosses on each side and the bottom of the motor. Any one of these sets can be drilled and tapped for the support of the motor. The bearing shields which

support the armature form the ends of the motor field, and make it dust proof. These motors can thus be operated with perfect safety and certainty under shop conditions which would work injury to other types of motors used in crane service.

The Sprague crane motors readily lend themselves to the application of crane service without altering the existing designs. Special attention has been given to the design and construction of the brush holders with the result that even with the frequent reversals of direction required in the operation of crane motors a most satisfactory service is obtained. They are simple and compact, with ample capacity for carrying the current, and are mechanically strong, with nothing to work loose or get out of order.



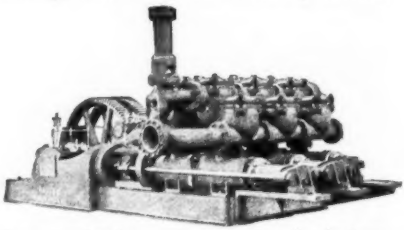
The brush holders are so designed that the carbon may be fed to the commutator until almost wholly used, with the tension on the brush being practically uniform throughout its whole life. The motors are wound so that no shifting of the brushes is necessary under any conditions of operation. They are fully enclosed so as to protect the working parts from fumes, dust and particles of foreign substances which are likely to rise in localities where cranes are used.

A full description of these motors may be obtained by addressing the manufacturers, Sprague Electric Company, 527 West 34th street, New York.

Electric Mine Pumps.

THE Goulds Manufacturing Co., Seneca Falls, N. Y., has for several years given special attention to electric pumps for mines. Hundreds of their efficient pumps are in use all over the world giving the best of satisfaction, and the renewal of orders from old customers is an evidence of the high esteem in which they are held by those that use them.

The Goulds double-acting triplex plunger mine pump, which is illustrated, was especially designed for mine service, and has many advantages. It is a "low down" pump requiring but a small amount of head room, and can be taken to pieces and lowered through an ordinary mine shaft. It is built in a number of sizes for elevations from 350 to 3,500 feet. The valves are all on top, where they can be easily reached



for examination and repairs by simply loosening the nuts that secure the valve box covers and dropping down the swing bolts. The plungers are outside packed and the cross heads are fitted with adjustable babbitted shoes which run in bored guides.

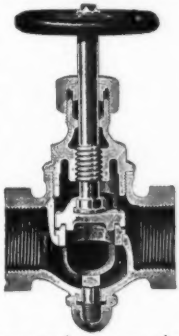
The double gears are of close grained cast iron and the pinions of steel, both machine cut from the solid.

The crank shaft is forged steel in two pieces and single throw with gears on the inner side. The crank shaft bearing surfaces have wedge and screw adjustment of special construction to keep the shafts in perfect alignment. The six cylinders are charcoal iron with heavy cast bronze linings. The valves are extra heavy bronze with leather or rubber faces as may be desired, and where exceptionally gritty or acidulous water is to be handled especially constructed valves can be furnished.

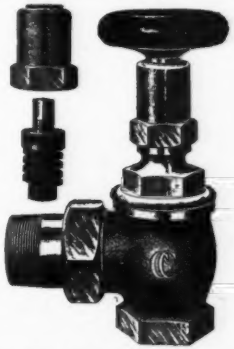
The pump illustrated is 7½" x 16", having a capacity of 660 gallons per minute against a pressure of 300 pounds or an elevation of 700 feet, and is furnished with a spring alleviator in place of an air chamber. Seven of these pumps 5½" x 16" have recently been installed in the DeBeers diamond mines, South Africa. The combined capacity is 3,600,000 gallons every 24 hours. They are located 1,300 feet below the surface and all connected to a common discharge. Each pump is direct connected to a Westinghouse electric motor.

A New Crane Valve.

CRANE CO. have recently brought out a line of improved renewable seat and disc globe and angle valves. These valves are suitable for working pressures up to 250 pounds and are tested to 700 pounds pressure per square inch. As the accompanying cuts will show they embody several new features in their construction which will be readily appreciated. The renewable parts are made of hard composition. They are especially suitable for any heavy duty where extreme pressure is used and where the wear and tear on the valve is mose severe.



By unscrewing the nut on bottom of the valve all parts are accessible and removable from the top, thus making it convenient to substitute a new seat or new disc when required, or to replace any worn part. The disc being attached to the stem by a slot, it is easily removed and replaced. The seat

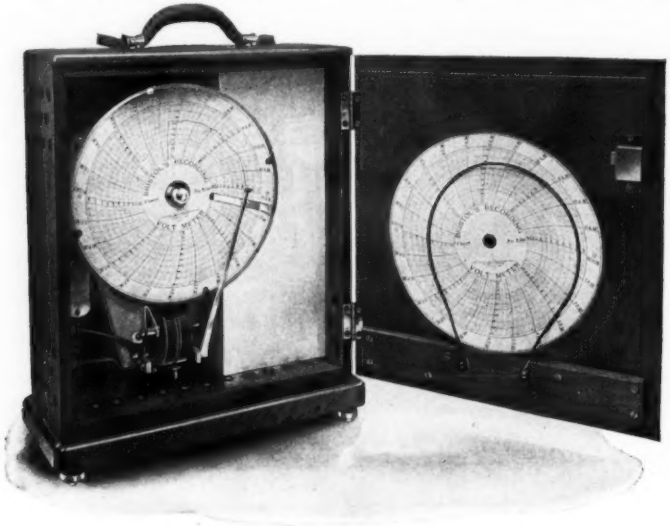


and disc can be removed and the two ground together if necessary. The construction of these valves is such that they may be packed when open without steam escaping.

New Recording Voltmeter.

THE importance of maintaining uniform voltage in the generation and distribution of electricity for light and power has long been appreciated by both the producer and the consumer. A variation of comparatively a small percentage in the voltage of an incandescent lighting circuit from the standard for which the lamps are designed causes great loss in the life of the lamps and results in wide fluctuations in the efficiency and candle power. In the application of electric power, as, for instance, on an electric railway, it is of great importance that the voltage be maintained regardless of the variations in the load. The recording voltmeter has proven itself to be of great value, and is an indispensable part of a modern electric plant, since it accurately, automatically and continuously furnishes a written record of the slightest variation of the voltage. The recording voltmeters manufactured by the Bristol Company, of Waterbury, Conn., have been extensively adopted, but up to the present it has been necessary to furnish the instruments with entirely different current coils, according as they were to be employed upon alternating or direct current circuits. In many electric plants both alternating and direct current are generated, and if

the same voltmeter can be used equally well for recording either kind of current, it is quite evident that a valuable advance has been made. This has been accomplished, and Fig. 1 illustrates the standard station or switch-board design. In Fig. 2 a special portable form of the instrument is shown. The case is provided with a handle and levelling screws for convenient transportation and adjustment. The door is open, showing the construction and manner of operation. The novel features and improvements to this new voltmeter are, first, it is equally applicable to both alternating or direct circuit; second, it requires only one-third as much current to operate as that necessary for the older design for alternating currents; third, it is more sensitive to very slight variations of voltage; fourth, the chart graduations are nearly uniform on both sides of the working range; fifth, the portable form of the instrument in its carrying case is only half the size and weight that was formerly required.



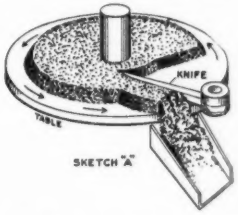
The solenoids shown in Fig. 2 are connected so that when current is passing through them in series, the movable solenoid will be repelled from, instead of being attracted towards, the stationary one. The movable solenoid is mounted on a frictionless knife edge multiplying device, which transmits its motion to the pen arm, carried by the knife edge blade. This simple multiplying device permits the solenoids to be located very near each other, and consequently the magnetic field of force is uniform throughout the motion of the solenoid resulting in the desirable scale divisions of the chart. By making the constructions of the solenoids so that there is repulsion instead of attraction, the mutual inductance between them is neutralized, thus making the same instrument suitable for recording either alternating or direct current. The instrument is independent of the rate of alternations and is compensated for changes of atmospheric temperature.

The Trump Measuring Machine.

THE Trump measuring machine consists of a horizontal revolving table on which rests the material to be measured, and a stationary knife set just above the table and pivoted on a vertical shaft outside the circumference. The knife can be adjusted to extend the proper distance into the material and peels off, at each revolution of the table, a certain amount which falls into the chute. The material peeled off is replaced from the supply contained in a bottomless storage cylinder somewhat smaller in diameter than the table, and revolving with it. The distance between the

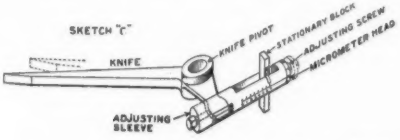
bottom of the cylinder and the table, the width of the knife and the depth of its cut determine the quantity measured off.

The depth of the cut is adjusted by swinging the knife around on its pivot so



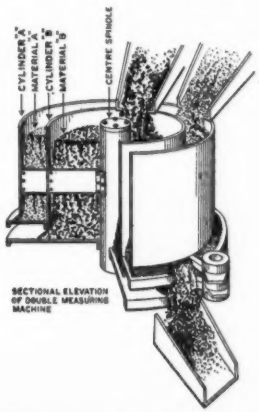
that it extends a greater or less distance into the material. This swing is controlled by a screw attached to an arm cast as part of the knife. A micrometer scale with pointer indicates the position of the knife.

When it is desired to measure off and



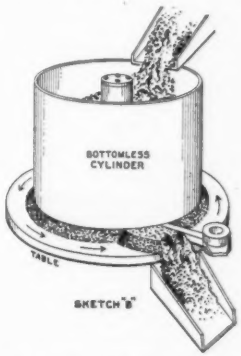
mix two or more materials, the machines are made with two or more tables set one above the other, and mounted on the same spindle so that they revolve together.

Each table has its own storage cylinder above it, the cylinders being placed one



within the other. There is a knife with its own adjusting mechanism for each table, which enables the user to vary at will the percentage of each material in the mixture. The materials flow together constantly and regularly in small streams into the common chute, the particles becoming intimately mixed; each infinitesimal amount of one ingredient being accompanied by the proper amounts of the other ingredients.

Materials can be fed to the storage cylinders by conveyors, by gravity from a storage bin, or by shoveling; and it is only necessary to see that enough is kept in the storage cylinders to insure that the amoun which the knives peel off will be constant With some finely powdered materials, which flow very freely, feeding-seals are placed at the top of the storage cylinders

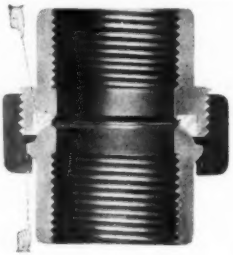


to regulate the density and pressure of the contents. The tables and storage cylinders are all mounted on and driven by the same center sleeve, which is carried on a dirt-proof step bearing provided with an oiling device. The lowest table has a bevel gear on the under side driven by a pinion mounted on a counter shaft. The casing of the machine is made dust-proof to prevent loss of materials or pollution of the air. The whole is self-contained on a substantial base, and can be driven by a motor or by any convenient shafting. Made by the Link-Belt Engineering Co., Philadelphia.

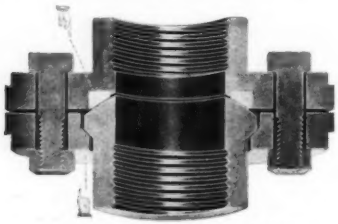
The Jefferson Union.

THE Jefferson union and coupling is made of malleable iron, having a bronze seat with the minimum amount to do the work effectively. It is so encased in iron that under no circumstances will it become loosened by the unequal expansion or contraction of the two metals. As shown in the illustration, it is protected from any liability of becoming injured or

dislodged by the pipe ends, no matter how far they are screwed in. Equally important is the added strength gained by having all made of malleable iron, so that the pipe ends never spread or get strained when connecting. It can be used over and over again, an impossibility with unions having brass ends. It is equally adapted to the use of steam, water, gas, or air, especially where high pressure is needed. In the construction of the East Boston tunnel it was subjected to 3,000 pounds' pressure per square inch, and did the work satisfactorily where other unions had failed. Being spherical in shape and thoroughly ground, becomes self-seating and very easily applied, doing away with all washers and gaskets. The Jefferson flange is made in all sizes from 1 inch to 12 inches by Jefferson Union Co., Lexington, Mass.



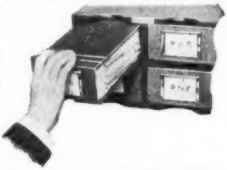
SECTIONAL VIEW.



JEFFERSON THREE-PART FLANGE.

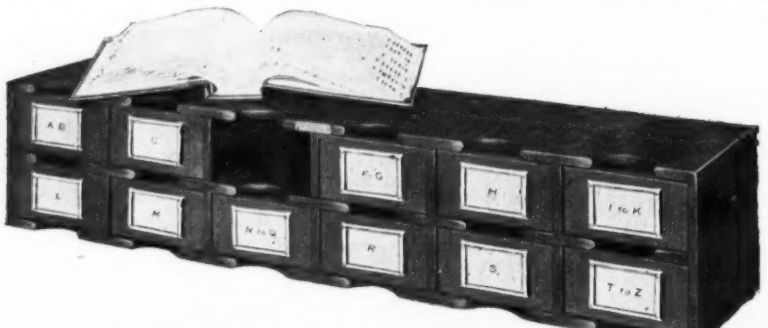
Loose Leaf Improvement.

THAT the card index has many inherent defects is recognized by everybody who has ever used one for any considerable time. Its flexibility, however, placed it far above bound books for reference records and it is probably more widely used than even the typewriter. A loose leaf binder is now to be had, however, which is claimed to excel the card index in convenience of recording and reference. The principal advantage comes through the book form of this loose leaf binder. It is much easier and more natural to open a book and refer to any page and make a notation if desired, than to search through a drawer, remove a card and find a suitable place to rest it before writing. Its place must be then found again to return the card, always with a chance of putting it in the wrong place.



For the proper housing of such record books special cabinets are made, as shown in the illustrations herewith. These range in capacity from two to twelve books, each book fitting in a separate dust-proof compartment. The twelve-volume cabinets, being made in sectional form, can be stacked together, a sufficient number making a complete cabinet of any desired size.

This loose leaf system suggests many possibilities in making and referring to any kind of record, and fuller information will be furnished upon application to John C. Moore Corporation, 313 Stone street, Rochester, N. Y.



NEWS SUPPLEMENT

Personal.

—Arthur Warren has resigned his position as manager of publicity for Allis-Chalmers Co., and will sail for Europe on an important journalistic mission.

—Robert McF. Doble, consulting engineer, San Francisco, has severed his connection with the Abner Doble Co. in order to resume his individual practice.

—Charles W. Lawrie, for several years general superintendent of the Ball Engine Co., has accepted the position as general superintendent of the Reeves Engine Co., Trenton, N. J.

—Albert J. Pitkin, president of the American Locomotive Co., died November 16th. When the American Locomotive Co. was formed he was elected vice-president and after the death of President S. R. Calloway succeeded him.

—R. E. Mathot, a Belgian engineer well known in the United States as an authority on the construction and testing of gas engines and other internal-combustion motors, is at present in this country, and will visit a number of important industrial centers on a tour of inspection and consultation. Mr. Mathot has already been in New York, to which city he expects to return about December 10, being in Cincinnati on December 1, and in Pittsburg December 6-7, and he will be glad to meet and confer with engineers or manufacturers interested in the subject of modern internal-combustion motors, or to receive correspondence. Mr. Mathot may be reached through the offices of THE ENGINEERING MAGAZINE.

Industrial Notes.

—Broderick & Bascom Rope Co., St. Louis, have opened a branch office at 19 Murray street, New York.

—The Brooklyn Heights Railway Co. have recently placed an order with the Westinghouse Electric & Mfg. Co. for 300 No. 101-B Westinghouse D. C. railway motors and 150 sets of controllers.

—The Nevada Consolidated Copper Co., Nevada, has closed a contract with the Allis-Chalmers Co., Milwaukee, for a battery of six large sized McDougall roasting furnaces, each with six hearths.

—Chicago & Northwestern Railway have extensive plans on hand for the construction of a line across Wyoming; another across Dakota; and a third across Northern Wisconsin and the Michigan Peninsula. New towns are being opened on all of these newly constructed roads.

—The De La Vergne Machine Co., New York, have recently been given a contract for three 500 horse power Koerting gas engines to be direct connected to 325 kilowatt, 550 volt direct current Crocker-Wheeler generators for the Boston Elevated Co.

—R. D. Nuttall Co., Pittsburg, have lately installed one of the largest gear cutting machines for cutting gears by the milling process that is manufactured. This machine will allow them to cut spur gears up to 20 feet in diameter, 3 feet face and up to 7 inch P tooth.

—Owing to the steady growth of its business, the Pelton Water Wheel Co., San Francisco, is obliged to enlarge its works, and to that end has purchased a block of land in South San Francisco, where a modern machine shop is now under course of construction.

—The Yampa Smelting Co. have just closed a contract with the Allis-Chalmers Co., Milwaukee, for six McDougall furnaces, to be installed in the Salt Lake City plant. The furnaces are of the standard Klepetke-McDougall type, but with all the latest improvements in details.

—G. M. Gest, New York, has been awarded the contract for the construction of a complete subway system at Chattanooga, Tenn., for the East Tennessee Bell Telephone Co. This is the first conduit work installed in the City of Chattanooga and the system will be a very large one.

—The increasing business of the Morse Chain Co. has necessitated the building of a large new plant at Ithaca, N. Y., which will be operated in conjunction with the present factory of the company at Trumansburg, N. Y. It is their intention to make

this new plant a model one in every way and ample facilities for future expansion will be provided.

—Owing to the rapidly increasing Southern business, the De La Vergne Machine Co., New York, has established a branch agency at Atlanta, Ga. This agency is to cover the States of North Carolina, South Carolina, Alabama, Florida and Georgia. Their representative will be W. M. Hargreaves, and the office will be located at 510 Candler Building.

—Pratt & Whitney Co. have purchased a plant in Dundas, Ontario, for the manufacture of their full line of small tools. The building is a modern structure, and the power plant is already in place. The plant will also include a department for manufacturing a full line of twist drills, an elaborate equipment of special machinery having been installed for the purpose.

—The Model Stoker Co., Dayton, have equipped 1,000 horse power Stirling boilers with the Model automatic furnace for the Home Lighting, Power & Heating Co., Springfield, Ohio; also 1,000 horse power Wickes vertical boilers for the Saginaw Plate Glass Co., Saginaw, Mich; 1,200 horse power Stirling boilers for the Friend Paper Co., West Carrollton, Ohio, and 1,200 horse power for the B. F. Goodrich Co., Akron.

—The Westinghouse Electric & Manufacturing Co. will have a new line of ceiling and floor column fan meters on the market the coming season, both direct and alternating current. These fans will have four blades and ball bearings, and be finished in black enamel and oxidized copper. The alternating current fans will be of the induction type and the direct current fans will be furnished with three-point switches.

—Robins Conveying Belt Co., New York, has just closed a contract with the Bartlett, Hayward & Co., Baltimore, for belt conveyors intended for the retort house of the Astoria Light, Heat & Power Co. Among other work this company now has on hand is the manufacture of belt conveyors and elevators for the Burnham Coal Co., Boston, and of belt conveyors for the U. S. Smelting Co., Salt Lake City.

—The two most important buildings being erected in the retail districts of New York and Chicago are to be ventilated throughout by American Blower Co. apparatus. Eighteen large fans and heaters and tempering coils containing an aggregate of about sixty thousand feet of one inch pipe will be used in equipping the Altman Building, New York, and the Marshall Field Building, Chicago.

—Pittsburgh Gage & Supply Co., Pittsburgh, report the following concerns among recent purchasers of their white star oil filters: Wabash Clay Co., Veedersburg, Ind.; Lalande & Grosjean Mfg. Co., Harrisburg, Pa.; Campbell & Wright, Tuskegee, Ala.; Gilmore & Davis Co., Tallahassee, Fla.; Driggs-Seabury Ordnance Corporation, Sharon, Pa.; and Schmulbach Brewing Co., Wheeling, W. Va.

—Wellman - Seaver - Morgan Co., Cleveland, have been awarded by the United States Government, the contract for crane service over two ship building berths, at the U. S. Navy Yard at Mare Island, San Francisco. This is one of the most important contracts in this line that has been placed for a long time, comprising an immense steel trestle and a powerful high-speed cantilever gantry crane mounted on same and traversing over the two berths.

—Broderick & Bascom Rope Co., St. Louis, were awarded gold medals by the Lewis & Clark Centennial Exposition at Portland in the following groups: wire ropes, cables for transmission of power, aerial cables for transportation of ore, hawser steel cables for marine use, and wire rope and aerial cables for mining purposes of all kinds. They were also awarded a gold medal for originality of design of the exhibit.

—Plans are being prepared and building operations will commence at once on a four story brick and steel factory addition to the plant of The National-Acme Manufacturing Co., Cleveland. It is hoped to have the building in readiness for occupancy early in 1906. The four story addition built during the past summer afforded only slight and temporary relief to the crowded condition of all departments, and the present capacity will be more than doubled when the improvements under way have been carried out.

—The Pelton Water Wheel Co., San Francisco, has closed an important contract

with the Oro Water, Light & Power Co., Oroville, Cal. This covers two complete Pelton units of 2,000 horse power capacity each, direct connected to electric generators. Sturgess governors will be employed. Other recent orders are: a wheel equipment for the Crown Columbia Paper & Pulp Co., Washington, consisting of a triple Pelton unit for direct connection to heavy pulp grinders in the paper mills. Takata & Co. have ordered a 300 horse power unit for Tokio, and a large wheel has just been furnished the Ingersoll-Sergeant Drill Co. for direct connection to one of their compressors.

—Sullivan Machinery Co., Chicago, are installing for the North Carolina Granite Co., Mt. Airy, N. C., a Sullivan Corliss, two stage air compressor for driving the Sullivan drills and other compressed air appliances, used at its quarries. This compressor has a capacity of 2,000 cubic feet of free air per minute, at 78 revolutions. The air cylinders are connected to a Sullivan Corliss, cross compound, condensing steam end, especially designed and proportioned for this purpose. The air inlet valves are of the Corliss type, operated by independent eccentrics, and the discharge valves on both cylinders are of the automatic poppet type, moving in a direction parallel with the piston rod, with removable seats located in the cylinder heads. The devices for cooling the air during compression are unusually efficient. A similar machine is installed at the works of the Southern States Portland Cement Co., Rockmart, Ga.

—The Westinghouse Machine Co., Pittsburg, have received many orders for gas engines, ranging from 10 British horse power to 1,000 British horse power. One of the most recent orders was received from the Rockland Electric Co., Hillburn, N. Y., for two 500 horse power double acting horizontal tandem gas engines. Another order is one from The Union Traction Co. of Kansas, Independence, Kan., for one 500 horse power horizontal tandem gas engine and one 1,000 horse power horizontal twin tandem gas engine. Other orders were received from the Sherwin-Williams Co., Newark; American Sheet & Tin Plate Co., Pittsburg; The Sidney Electric Light Co., Sidney, Ohio; J. C. Sterns Electrical Co., Buffalo; American Snuff Co., New York; Northwestern Lithographing Co., Milwaukee; Granite City Hospital, Granite City, Ill.; American Locomotive Works, Allegheny, Pa.; American Acid & Alkali Co., Bradford, Pa.; Amolyo Mining Co., New York; Home Light, Heat & Power Co., Pittsburg, Kan.; Pittsburg (Pa.) City Hall.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Air Compressors.

Sullivan Machinery Co., Chicago.—Catalogue No. 53, entitled "Modern Practice in Air Compression," containing a well-illustrated description of the many different types of air compressors manufactured by them. Also contains many tables giving much valuable data. 6 by 9 in.; pp. 128.

Drilling Tools.

St. Louis Well Machine & Tool Co., St. Louis.—Circular 1, illustrating and describing the full line of drilling tools manufactured by them, together with prices, sizes, etc. 7½ by 10 in.; pp. 16.

Electric Drills.

Chicago Pneumatic Tool Co., Chicago.—Special circular No. 52 containing an illustrated description of their air cooled Duntley electric drills, together with tables of tests. 9 by 6 in.; pp. 12.

Electrical Equipment.

Fort Wayne Electric Works, Fort Wayne, Ind.—Bulletins Nos. 1067, 1068 and 1070 illustrating and describing type A transformers, type M induction motors and series A. C. arc lighting system respectively.

Foundry Supplies.

S. Obermayer Co., Cincinnati.—The Obermayer Bulletin for Sepptember-October contains much information of a valuable nature to foundrymen. 6 by 9 in.; pp. 32.

Gas Engines.

Foos Gas Engine Co., Springfield, Ohio.—Catalogue No. 16 treating of Foos gas and gasoline engines adapted to all power purposes. Illustrated. 10½ by 8 in.; pp. 40.

Gas Producers.

Automatic Gas Producer Co., New York.—Pamphlet containing an illustrated description of

their automatic gas producer. Also contains table showing the analyses of gas made by the automatic gas producer from bituminous coal. 6 by 9 in.; pp. 10.

Gears.

R. D. Nuttall Co., Pittsburg.—Booklet entitled "Part of Plant and Product," printed in two colors, containing a brief description of their plant and products, together with many fine illustrations.

Heating Apparatus.

American Blower Co., Detroit.—Catalogue No. 186 describing "A B C" heating apparatus for the heating and ventilating of factories and public buildings and the drying of materials of all kinds. Is well printed and finely illustrated. 7 by 9 in.; pp. 32.

Hoisting Drum.

The Hayward Co., New York.—Well-printed booklet describing their hoisting drum. Illustrated. 3½ by 6 in.; pp. 12.

Hydraulic Accumulators.

Watson-Stillman Co., New York.—Catalogue No. 67, containing a description of their hydraulic accumulators and fittings, together with tables giving dimensions, prices, etc. 6 by 9 in.; pp. 68.

Hydro-Electric Plant.

The Arnold Co., Chicago.—Bulletin No. 13, describing in detail the hydro-electric plant of The Spring River Power Co., Joplin, Mo., including the transmission lines and sub-stations. 9 by 12 in.; pp. 16.

Ice Machines.

Larsen Ice Machine Co., Omaha.—Catalogue, printed in two colors, containing an illustrated description of the Larsen ice machines, together with a partial list of plants recently installed. 10 by 8 in.; pp. 48.

Mine Locomotives.

Jeffrey Manufacturing Co., Columbus, O.—Bulletin No. 10, illustrating and describing the many different styles and sizes of mine locomotives manufactured by them. Is well printed and contains many views showing the locomotives in operation. 8 by 10 in.; pp. 68.

Mechanical Machinists' Tools.

Brown & Sharpe Mfg. Co., Providence.—Catalogue No. 107, containing a description, together with price lists, of their mechanical machinists' tools. 6 by 9 in.; pp. 164.

Oil Engines.

De La Vergne Machine Co., New York.—Catalogue treating of the Hornsby-Akroyd oil engines. Contains numerous testimonial letters and a list of users. Is well printed and illustrated. 9 by 6 in.; pp. 74.

Pipe Crushing Machine.

United Engineering and Foundry Co., Pittsburg.—Leaflet containing a brief description, with two illustrations, of their pipe crushing and shearing machine for use in tube mills, steel plants and scrap yards.

Power Presses.

E. W. Bliss Co., Brooklyn.—Catalogue containing a brief description, together with illustrations, of the many different styles of power presses for manufacturing pieced tin and iron work. 5 by 7 in.; pp. 80.

Pumps.

Emerson Steam Pump Co., Alexandria, Va.—Catalogue containing an illustrated description of their pumps, together with many illustrations showing the pumps in operation. Quick cleaning strainers and foot valves are also treated. 6 by 9 in.; pp. 38.

Rotary Converters.

Westinghouse Electric and Manufacturing Co., Pittsburg.—Special publication No. 7038, treating of Westinghouse rotary converters, their characteristics and construction, with instructions for their erection, operation and care. 6 by 9 in.; pp. 68.

Saw Mill Cariages.

Allis-Chalmers Co., Milwaukee.—Catalogue No. 123, containing an illustrated description of their saw mill carriages and accessory machinery, together with views showing many recent installations. 8 by 10½ in.; pp. 48. Also pamphlets illustrating and describing their steam shovels; Hancock jig; McDougall roasting furnace; single-stage centrifugal pumps; and high-duty plunger pump.

Separators.

Austin Separator Co., Detroit.—Catalogue No. 15, illustrating and describing their extensive line of separators. The subject matter in this catalogue is a complete exposition of the theory and principles of construction of the best types of separators. Also contains numerous testimonial letters. 6 by 9 in.; pp. 52.

Steam Specialties.

Watson & McDaniel Co., Philadelphia.—Booklet, pocket size, containing an illustrated description of their full line of steam specialties for power plants and steam heating. 3¾ by 6½ in.; pp. 48.

Stone Working Tools.

Ingersoll-Rand Co., New York.—Bulletin No. 2004, issued by their pneumatic tool department, illustrating and describing their pneumatic stone working tools. 6 by 9 in.; pp. 16.

Storage Batteries.

Westinghouse Machine Co., Pittsburg.—Small folder issued by the storage battery department, devoted chiefly to illustrations of their storage batteries for railway signal service.

Tool Steel.

Wm. Jessop & Sons, Ltd., New York.—New catalogue of sizes of tool and other kinds of steel. Also contains much valuable information on the hardening and tempering of tool and die steel. 3½ by 6 in.; pp. 56.

Well Drilling Machinery.

American Well Works, Aurora, Ill.—Bulletin No. 95, containing illustrations and description of the different sizes and styles of well-drilling machinery manufactured by them. Bulletin No. 94 treats of artesian well pumping machinery.

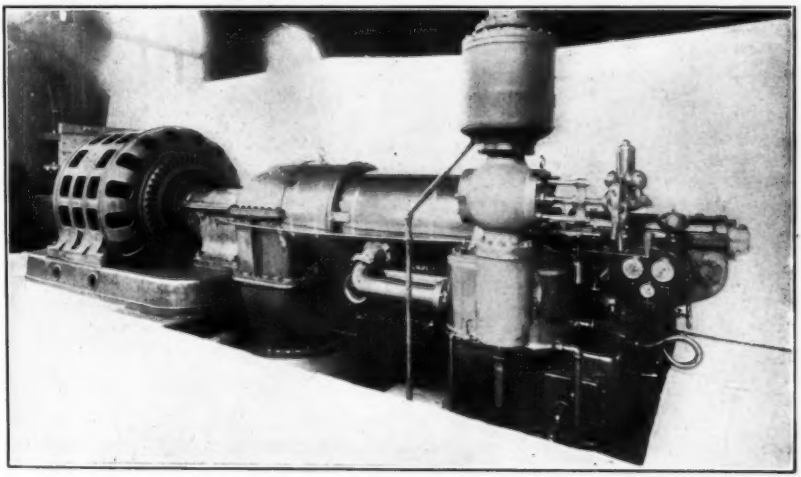
IMPROVED MACHINERY

New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Allis Chalmers Steam Turbine.

THE recent starting up of a steam turbine at the Washington street power house of the Utica Gas & Electric Company, Utica, N. Y., calls attention to the fact that this is the first turbine to be put into operation by the Allis-Chalmers Company, who have recently entered the steam turbine field. The turbine outfit installed at Utica is shown by the accompanying illustration.



This turbine is rated at 1,500 kilowatts normal load, and runs at a speed of 1,800 revolutions per minute. It is direct coupled to an Allis-Chalmers two-phase, sixty-cycle revolving field alternator, operating at 2,500 volts. The unit has a continuous overload capacity of twenty-five per cent., with a three-hour fifty per cent. overload capacity without exceeding a safe generator temperature, and capable of a one hundred per cent. safe momentary overload. Artificial ventilation by means of an electrically driven fan blower will, however, enable the unit to be run safely beyond its rated overload capacity. The turbine follows the well-known Parsons type which has proven eminently successful in numerous installations. The Allis-Chalmers construction, however, embodies a number of new features, which the builders claim to be distinct improvements. The chief distinguishing feature of this construction is the blading, which, while it is of the Parsons reaction type as regards the principle of operation, differs in mechanical construction in a number of essential details.

The roots of the blades are formed in dovetail shape by special machinery, and are inserted in slots cut in foundation or base rings; these slots being formed by special machine tools in such a way as to exactly conform to the shapes of the blade roots. The foundation rings themselves

are of dovetail shape in cross section and are inserted in dovetailed grooves cut in the turbine cylinder and spindle respectively, in which they are firmly held by key pieces, much in the same way that the well-known Lewis bolt is fastened. In order to further ensure the integrity of the construction, the key pieces or rings after being driven into place are upset into undercut grooves.

Another noticeable feature of the blading is the method of reinforcing and protecting the tips of the blades. This point

in steam turbine design is one upon which much thought has been expended by various inventors, and the Allis-Chalmers Company claim that the construction employed by them successfully solves all difficulties. In forming the blades a shouldered projection is left at the tip. This is inserted in a slot punched in a shroud ring; the slots being punched by special machinery in such a way as to produce accurate spacing and at the same time form the slots so that they will give the proper angles to the blades independent of the slots in the base ring. After the blade tips are inserted in the slots in the shroud rings they are riveted over by specially arranged pneumatic machinery.

The shroud rings are made in channel shape, with outwardly projecting flanges which, after assembly in the turbine, are turned and bored to give the necessary working clearance. The flanges of the channels are made so thin that, although amply sufficient for stiffness, the shroud ring does not have the disadvantage of a solid shroud which acquires a dangerous temperature by friction in case of an accidental contact of the rotating and stationary parts. It is claimed for this construction that the blades are stiffened against the effect of vibration in a much more substantial manner than by any other means thus far employed, while the use of a protecting shroud ring enables the working clearance to be made smaller than in the case of naked blade tips, without danger in case of accidental contact, thus reducing the leakage loss to a minimum; the leakage past the blade tips being the principal source of loss in the steam turbine. As to the safety from damage in case of accidental contact, it is claimed that this has been proven by experiment

with actual blading, by throwing the bearings out of center so as to produce contact, without detrimental results. An incidental advantage claimed for this construction is that if by chance a blade should prove defective, it is so held in place by the shroud ring that it cannot possibly work loose and produce damage.

The photograph shows the general scheme of the blading, illustrating the method of fastening the blades as well as the channel shaped shroud ring.

The builders will furnish full details to inquirers.

Sash Operating Machinery.

THE ventilating machinery here shown was first applied for greenhouse ventilating about forty years ago. The principle, in different forms, is now used in

practically all the apparatus for this purpose. There is no better way of opening and closing sashes. Long lines of sashes can be swung easily and evenly to any desired opening. It is self-locking at any point, and cannot be altered except by turning the operating rod attached to the worm. It is wholly mechanical, being free from chains, cables and springs, which so often get out of order.

The apparatus consists of a rocking shaft, usually made of one-inch steel tubing, supported by hangers to the framework of the building, and continuing its length. As many lines of shaft are used as there are lines of ventilators. The hangers supporting the shaft are usually placed on the muntins separating the sash, but can be placed below or above the sash, and on roofs either on the rafters or can be fastened directly to the roof boards. Different conditions govern the distance between hangers, but under ordinary circumstances they can be placed from 6 ft. to 8 ft. apart.

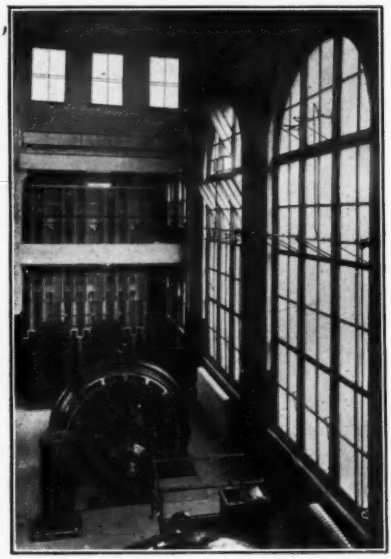
Arms and rods are fixed to the shaft opposite each sash, one or more to each sash according to its length, and are attached to the sash to be opened, either on rails or stiles, by means of a small cast rod hanger. Sash up to 4 ft. in length can be operated with one set of arms and rods to each sash, but in order to prevent racking the sash the use of two sets on each sash is advisable.

The shaft is made to rock by means of a gear and worm, secured together and to the shaft by means of a yoke. The rocking shaft opens and closes the sash by means of arms and rods. When the sashes are open, their weight is carried by the rods and arms to the shaft, which is held by the gear, worm, and yoke in connection with a strong bolting collar fastened to the framework of the building. This arrangement relieves the operating rod of any strain other than that necessary to turn the worm in the gear. This rod is made of ¾-inch round cold rolled steel shaft, and is provided with a crank or hand wheel. It can be continued down from the ridge or a monitor, following the angles or curves of the roof by means of beveled gears or universal joints. Where the sash are not

more than 15 ft. from the floor line the machinery can be operated by means of a detachable handle.

The rocking shafts on the various angles

or sides of a building can be attached so as to operate as one shaft by means of universal joints or bevel gears. The length of a line of ventilation to be controlled by



one set of gears depends upon conditions existing in each separate case. An average example would be 100 ft. of vertical sash, centre pivoted, controlled by one set of gears. This is as long a run as it is practicable to operate with any gear, in view of the fact that sufficient power must be transmitted to hold the end sash as well as the centre ones tightly closed, and to open them, even if slightly bound with ice, as is often the case.

Full details, etc., may be had from Burnham-Hitchings-Pierson Co., 1133 Broadway, New York.

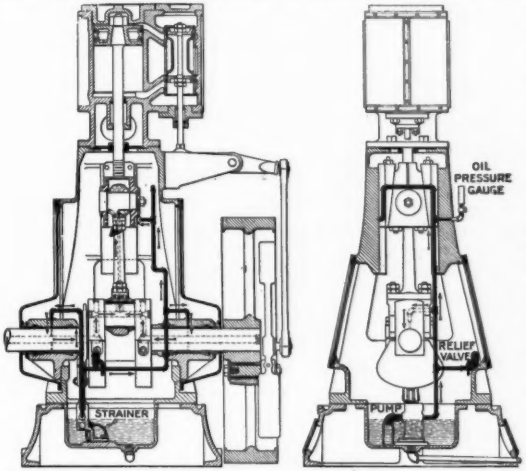
Sturtevant Vertical Engines.

THE Sturtevant vertical engines of class VS5 are high speed and automatic. A system of forced lubrication and the complete enclosure of the moving parts provide for continuous operation for weeks at a time without attention, and insure perfect reliability even in the hands of the unskilled. This type of engine is adapted to all classes of work requiring maximum power in minimum space; a condition attained by operation at the high speed made possible by the refined design, the high-grade construction, and the use of the best material. They are especially designed for the driving of direct-connected generators. Because of the large diameter and short stroke, they develop great power and high rotative speed without excessive piston travel.

Within the heavy cast-iron base, to which is bolted the lower part of the frame, a submerged oil pump, operated by the crank shaft, draws oil from the reservoir and forces it through pipes and internal passages in the moving parts to the crank pin, the wrist pin, and the main bearings. Twice during each revolution the reversal of stress on these parts, due to the double-acting feature of the engine, so reduces the pressure that the pump has an excellent opportunity to force between the surfaces a fresh film of oil which is carried around to lubricate the rotating parts when the pressure is greater. The pressure of 10 to 20 pounds per square inch positively maintains this film of oil, preventing actual contact of metal, reducing wear and friction to a minimum, and insuring a mechanical efficiency of over 90 per cent. Centrifugal oil guards located on the shaft just where it passes through the casing, together with the enclosing frame and the watershed partition insure perfect cleanliness and absolutely prevent the escape of the oil, which is continuously repumped to the bearings.

The watershed partition, a valuable and distinctive feature, prevents water from the piston-rod stuffing box mixing with the lubricating oil in the case and at the same time makes impossible the passage of oil from the enclosing frame to the interior of the cylinder. The piston-rod stuffing box may be readily adjusted without opening the case. This watershed partition forms a part of the enclosing frame which protects the parts from dirt and accident, insures economy, and eliminates the necessity of frequent attention; but the removable oil-tight plates or covers make the parts as accessible as in the open type of engine. The cylinder, with which is cast the valve chamber, is provided with relief valves which, by opening automatically at any pre-determined pressure, prevent possible damage by water. A planished sheet-iron cylinder casing enclosing a thick layer

of asbestos greatly reduces condensation. This lagging need not be disturbed, for the cylinder is tapped for the indicator. The flow of steam to and from the cylinder is controlled by a perfectly balanced piston valve possessing the simplicity of the plain

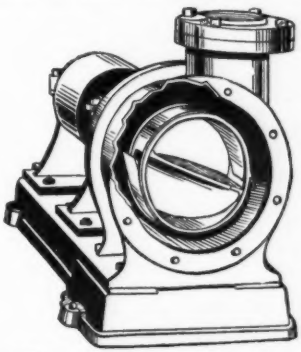


slide valve, but requiring the minimum of power to operate. The snap rings on this valve insure tightness, and the bushing in which it moves may be easily replaced when worn. A Rites governor, placed within the heavy fly wheel, gives motion to the valve through the medium of a rocker, and alters the cut-off by changing the valve travel, permitting only 1½ per cent. variation in speed between no load and full load. The hollow cast-iron piston, strengthened by internal ribs, is fastened to the piston rod by a forced taper fit, secured by a nut. To prevent leakage without unduly increasing friction, the cast-iron packing rings are turned to a perfect contact.

Open-hearth steel is the material from which are forged the piston rod, connecting rod, and crank shaft, each from a single piece. The composition boxes of the connecting rod are lined with Sturtevant white metal hammered in and accurately bored; the cast-iron cross-head is equipped with adjustable shoes and a nickel-steel wrist pin; and the crank pin is of such unusually large size that it cannot heat for the intensity of pressure is always low and the lubrication ample and positive. Made by B. F. Sturtevant Co., Boston, Mass.

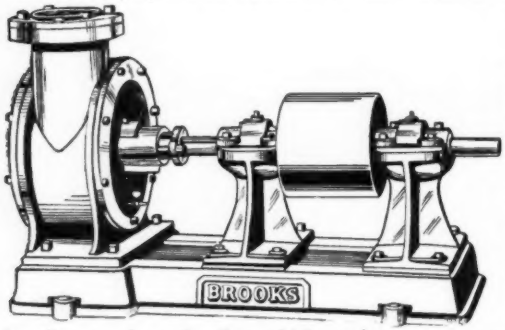
The Brooks' Centrifugal Pump.

THE Brooks pump marks a new step in the theory of centrifugal pumping machinery. In construction it is entirely different from any form of centrifugal pump known. The particular features which commend its use are the absolute clearance between the revolving impeller and the casing of the pump, noiseless working and efficiency. The impeller is nothing more than a hollow cylindrical casting, which is completely closed on the side nearest the bearing. The impeller has a partition which separates it into two parts. Each of the two compartments has openings, rectangular in shape, and above the openings, and forming a part of the casting of the impeller, are lips which, when the partition is vertical, stands at about 45° to the horizontal. The partition projects into the suction pipe. The impeller which is described is used for clean water or liquid having very little solid matter. However, in the case of sand the impeller is some-



what different, the main points being that there are no lips above the discharge orifices and that the rectangular openings are replaced by a spiral opening larger in area. The partition, however, projects as before a small distance into the suction. When the impeller is set in rotation the projecting partition starts the water in the suction pipe whirling. On going into the impeller

it follows a spiral path caused by the projecting partition rather than a straight path as in ordinary centrifugal pumps. Because of this the water tends to curve in a parabolic path to the discharge openings in the impeller rather than to be brought in violent contact with the back. This tends to minimize eddying and skin friction. As the



impeller revolves the lips which project above the discharge orifices displace the water which fills the pump and tend to push it forward as rapidly as the impeller is revolving. At the same time, because of the speed of these lips and because of the difference of pressure between the atmosphere and the inside of the pump there is a vacuum created back of each lip which tends further to draw the water from the impeller. Then at the same the centrifugal force is acting to throw the water through the discharge orifices.

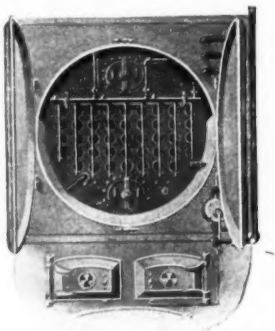
As a matter of fact these pumps show up remarkably well under test. At St. Louis with a 2" vacum pump an actual 30' suction was maintained against a pressure of 25 pounds on the discharge. The volume of water was 120 gallons per minute. The vacuum pumps create a vacuum of 29" on a 30" barometer.

These pumps have found great favor for dredging and irrigation work as well as for house work. They are noiseless, free from vibration and efficient. The pump can be built to any size ranging from 20 gallons a minute up to any capacity and on a single stage are capable of 130' on the discharge or on multi-stages can reach any height desired.

The Dayton Hydraulic Machinery Co., Dayton, Ohio, will send full description on request.

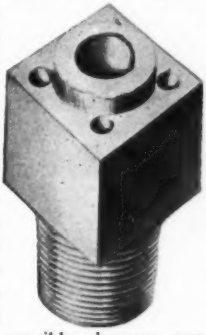
American Boiler Flue Cleaner.

THIS is designed to meet three of the most important requirements of the boiler room, viz., to reduce the fuel consumption, to lessen the labor, to prolong the life of the boiler, while at the same time increasing its efficiency. It differs radically from other cleaners in that it is designed as a permanent attachment to the boiler, ready to do its work by the turning of a valve. Five minutes' work each day will keep the fire tubes of any horizontal fire tube boiler always clean and free from soot or ashes. As shown in the illustration, connection is made from a dry steam line to a three-way valve on the outside of the boiler, shown under right hand door in cut. From the valve three pipes convey the steam to a header pipe in the front combustion chamber, from which drop pipes extend in front of each row of fire tubes, but far enough from the boiler head to avoid interfering in any way with the draft. In these drop pipes a jet is placed exactly in the center of each fire tube opening. The header and drop pipes are made in



three sections, and each section is supplied by one of the feed pipes from the three-way valve, a turn of the handle one point admits the dry steam into the first section, from which it is blown into the tubes connected with that section for not more than one minute; then the valve handle is moved another point, supplying the second section and shutting off the first section. This is repeated for the third section. By going

through a reverse motion the tubes are given another blowing out, of a half minute duration each, the whole operation not occupying five minutes to a boiler, and without in any way interfering with the operation of the boiler or disturbing the fire, or materially altering the boiler pressure. A drip cock is placed at the foot of the feed line to the valve so as to remove all condensation and provide dry steam before entering the three-way valve. As no wet steam is blown into the tubes no possible damage can be done to the fire tubes, and the life of the tubes is prolonged by keeping them always clean, without the use of a scraper or brush, saving the consequent wear and tear and labor, and preventing the buckling or expansion of tubes, while keeping the boiler up to its full working capacity at all times. An adjustable hanger attaches the apparatus to the boiler head,



and by means of a universal joint the header and drop pipes can be thrown above the top row of tubes should repairs be needed to the tubes. The small cuts show the jets used opposite each tube; these are made of brass, rendering them impervious to heat or corrosion, and enabling them to be readily removed when required. These jets are constructed for syphon action, drawing the air in with the steam to create an air and steam blast combined in each tube, and with sufficient force to clean the entire length of the fire tubes. The steam supply is reduced or throttled from boiler pressure to required pressure, an independent gauge and valve being used when required so that the steam can be economically used.

It will be readily seen that the first cost of the installation of this boiler can be saved in a short time, by comparing this method with the usual process of blowing out the fire tubes, banking the fires and lowering the steam pressure, opening up the front and back combustion chambers and blowing out and scraping each tube by hand—a process that takes from one to three hours of hard work. A very much smaller amount of steam is required, and at the close of each day's work or at the beginning of each day, five minutes' use of the American cleaner puts a clean boiler into operation. The cost of installation is apportioned to the sizes of pipes required for the size and number of boiler tubes. The apparatus can be used on any type of horizontal fire tube boilers, or on marine boilers of the Scotch type. The American cleaner has been installed for some time in a number of boiler rooms, where it has been severely tested, and found to meet all requirements, and has proven its value as one of the latest and best accessories to economy in steam production. The American Boiler Flue Cleaner Co., Broad Street Bank Building, Trenton, N. J., are the manufacturers, and further information will be had by application to them, or their New York office, Wilkinson & Hackett, 428 Temple Court building.

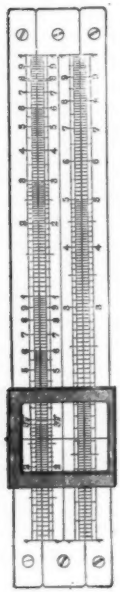
Kolesch's "Precision" Slide Rule.

THE Gunter scale, for decades of years a valuable aid to engineers, surveyors, navigators, etc., has been entirely superseded by the Mannheim slide rule. This has nowadays proved itself to be indispensable in every office and to everybody whose business involves calculation. Multiplication, division, involution, evolution and all other arithmetical, algebraical and trigonometrical functions can be performed on this rule mechanically with the greatest ease and rapidity and without mental strain.

Kolesch's "Precision" calculating rule embodies a great improvement over other similar rules. It is made of the very best well-seasoned, built-up, mahogany stock with white celluloid facings. The graduations are all engine divided, clearly and

accurately cut and being on a white background very legible. This is one great advantage of these rules over lithographed rules, which are on the market, and which will wear off in a short time, so that graduations and figures are illegible and indistinguishable.

The main improvement is the construction of the stock or body of the rule. The rules formerly constructed with celluloid facing on the inside of the groove only are always liable under changes of temperature, climate or humidity to expand, contract or warp.



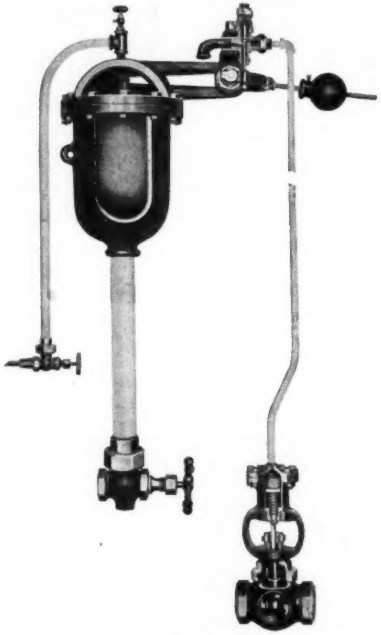
In the Kolesch "Precision" slide rule this drawback is entirely overcome by mounting the two faces of the backbone with celluloid, making the body unaffectable to changes of temperature or humidity.

The ends of the celluloid facings on these rules are fastened to the wood by German silver screws, which secure absolute adherence of the celluloid facings to the body of rule. These rules are manufactured five, eight, ten, fifteen and twenty inches long.

Kolesch & Co., 138 Fulton street, New York, will gladly furnish any information and descriptive price list of "Precision" slide rules, their deviations and circular calculators.

Automatic Feed-Water Regulator.

THE importance of keeping the water level in steam boilers constantly at the proper point has always been recognized. To say nothing of the danger of explosion due to low water in the boiler, the economic advantages of keeping a proper water level are so great as to commands the attention of all careful steam users. Steam boilers are designed to work most economically when the water is at the middle gauge, for at this point there is the maximum heating surface and the maximum steam space. The tendency of all water tenders is to keep the boiler too full of water, as they are then on the safe side. If a boiler is filled in three gauges, not only is the temperature of the boiler lowered, but the extra gauge of water is above the point of contact with the heat, and a large percentage of the heat in the fuel which must be consumed to convert it into steam is wasted. When the water level is kept uniformly at the proper point, the heat is constantly applied to the same amount of water at the same temperature. A further saving of fuel is obtained when the water is fed through the heater or economizer at a slow and uniform rate, for then the feed-water is heated to a higher degree than is



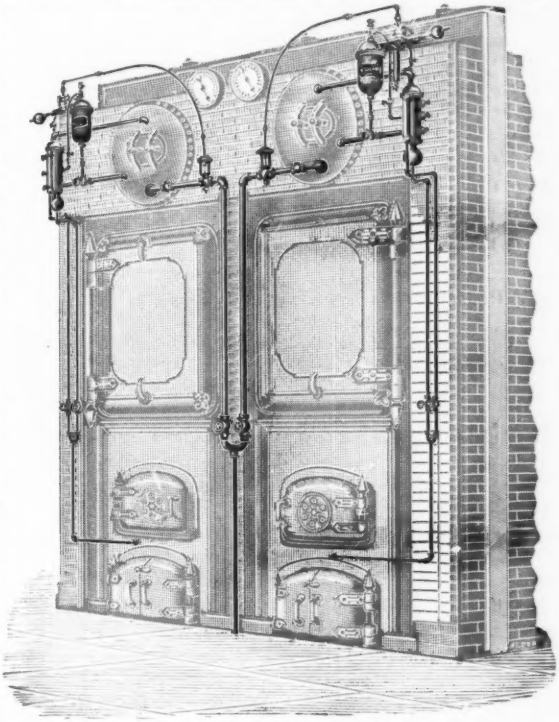
possible when the flow varies, as is always the case with hand feeding. A properly designed boiler will not prime or flood the steam pipes, if the water level is kept at the middle gauge. Nearly all of the cases of boilers priming and water in the engine cylinders are due to carelessness of the attendant in allowing the boilers to get too full of water. This causes great loss in cylinder lubrication, to say nothing of scored cylinders and the occasional loss of a cylinder head, or the cylinder itself. Modern steam engines are now built with

so little clearance that this danger is much greater than formerly.

Strains of expansion and contraction are inseparable from hand feeding of boilers. Boilers are chilled by changing water levels and temperatures, caused by suddenly feeding large quantities of water, even from a heater of 200 degrees. There is about as much difference in temperature between hot feed water at 200 degrees, and the temperature of a boiler at 125 pounds pressure, as there is between ice water and boiler water.

To overcome the disadvantages of hand feeding and meet the ideal conditions of the water level constantly maintained at a given point, L. B. Fulton, of the Chaplin - Fulton Mfg. Co., invented about 1895 the Vigilant automatic boiler feeder.

The cuts show a sectional view of the Vigilant feed water regulator and the same applied to a modern water tube boiler. The machine is attached to water column. The regulator consists essentially of three parts the first is a special brass nipple and gate valve combined, which is screwed into the water column at the point it is desired to carry the water level. From this a three-eighths inch pipe connection is made to the top of the chamber of the regulator. The second part of the apparatus is a hooded chamber, as shown. A one-and-a-fourth connection is made from the bottom of the chamber to the boiler, or to the bottom connection of the water column. Inside the chamber is suspended a weight, which is hung from the end of a lever, whose fulcrum is a shaft one end of which extends through a stuffing box, while the other rests on a step inside. To the protruding end of this shaft is keyed another lever which carries an adjustable counterweight, and at the fulcrum has a shoe with an adjustable set screw for lifting the stem of the actuating valve. This valve is attached to the top of the hood, and a steam connection made to the gauge pipe or other point where dry steam may be obtained. The valve has an upper and lower bearing so arranged that when against the upper seat the steam connection is closed and the bottom one is open to the atmosphere. When seated on the bottom seat the connection to the air is closed and the steam pressure is admitted to the controlling valve. The controlling valve is the third part of the regulator and is placed in the feed line to the boiler. In construction it is similar to a check valve, and the entering water tends to lift the valve. A stem extends from the valve through a stuffing box to a hood which has a mushroom top on which rests a diaphragm. Under the mushroom is a spring which tends to open the valve when there is no pressure on the diaphragm.



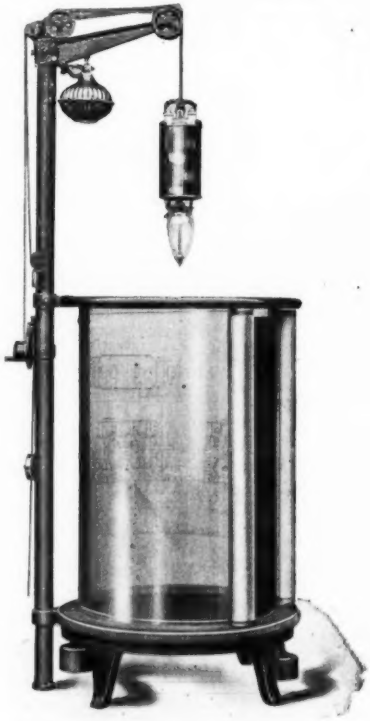
When the water level is below the open-

ing of the special nipple the regulator chamber will be full of steam, and the water in the pipe to the chamber will be the same height as in the column. The weight in the chamber is then heavier than the counterweight, and the latter will be in the top position and the actuating valve held against its top seat, and the exhaust will be open to the air. There can then be no pressure on the diaphragm, and the controlling valve will be wide and the boiler taking water. When the boiler fills up to the opening of the special nipple the steam will be cut off from entering the chamber, and the steam which was in it condenses and forms a partial vacuum so that the water from the boiler instantly fills it to the top. The inside weight then weighs less than it did when it hung in steam, by the weight of the water which it displaces. The counterweight is now heavy enough to overbalance the inside weight and goes down, while the inside weight goes up. As the outside lever goes down the actuating valve goes down, opening the steam connection and shutting the exhaust. This admits the steam pressure to the diaphragm chamber and forces the controlling valve down, so that the feed water is shut off at once. No more water can enter the boiler until the water level falls to the opening of the special nipple, when steam is admitted to the top of the chamber, the water in it falls to the old level, all the operations are reversed and the controlling valve opens again. These operations are repeated as the water gets above or below the desired point and the variation does not exceed one-half inch.

Full details of the working of the Vigilant feed-water regulator in actual practice will be sent on request to the Chaplin-Fulton Mfg. Co., Pittsburg, Pa.

Buckeye Blue Printer.

THE Buckeye electric blue printing machine, which has been manufactured and sold by the Buckeye Engine Co., Salem, O., during the last two years, is the first medium priced machine of its kind to be placed upon the market. In design and construction the machine is mechanically correct. The roller curtain device differs from any other in that weights are employed to secure the tension in place of the usual springs. This, the manufacturers claim, produces even contact over the entire surface of the glass and also removes the necessity of unrolling all of the curtain and fastening it to the frame to hold it in position when making small prints. As shown in the illustration herewith, the rollers will remain stationary at any point on the circle without fastening. The machine requires but one lamp, of the photo-engraving and enclosed arc type, requiring but little attention—one set of carbons



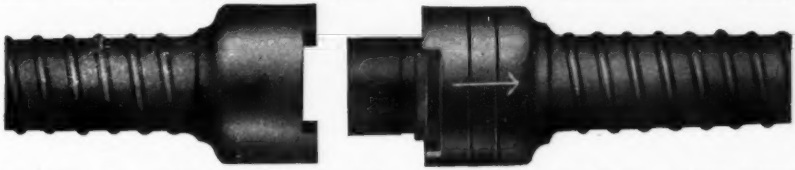
burning for one hundred hours. The machines are entirely self-contained, very simple and can be manipulated by a boy with as perfect results as by a skilled workman.

The reputation gained by the Buckeye Engine Co., through the steam engines they manufacture, is a sufficient guarantee of the excellence of the blue printing machine.

The manufacturers will send catalogue and other information upon application.

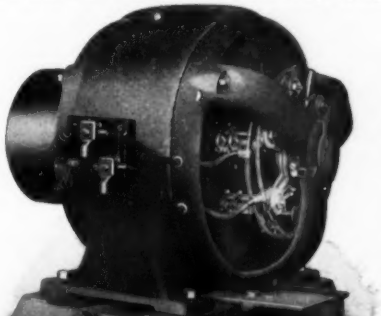
The Bowes Hose Coupling.

TWO views herewith will give an excellent idea of the outward appearance of the Bowes hose coupling, made by the Cleveland Pneumatic Tool Co., Cleveland, Ohio. To take it apart it is only necessary to move the sleeve in the direction indicated by the arrow, give a quarter turn and pull apart. It is claimed for it that it is automatic, quickly connected, and cannot of itself become disconnected; never leaks,—the higher the pressure the tighter the joint. The gasket cannot be lost, and is replaced in a moment's time and at trifling cost when worn out. The thread on the shank of the coupling makes it easy to screw into the hose, and is also valuable in holding the hose in the coupling.



Sprague Round Type Motors.

THE bipolar round type Sprague motors have been so long and favorably known, that no description of them now is needed, but we give in the accompanying illustration a view of the type D motor, which the Sprague Electric Company is now putting on the market. These new motors range in size from 10 to 105 horse power and are made entirely enclosed, semi-enclosed and open. The small sizes are bipolar, but from 20 horse power up they are multipolar. The type D motors in every respect fulfil the high standards of the Sprague electric apparatus, and the excellent features of their design and construction are a guarantee of their quality.



A complete description of these motors is given in Bulletin No. 2247, which may be obtained by addressing the Sprague Electric Company, New York.

Quick-Opening Radiator Valve.

AN illustration on the next page shows the Crane self-packing, quick-opening steam radiator valve. The self-packing feature precludes any possibility of the valve leaking at the stuffing box, thus saving from ruin carpets and rugs, the spotting and warping of floors, and the general annoyance caused by leaky stuffing boxes. By a special device, placed in the stuffing boxes of these valves, the packing is automatically kept tight and will last for years without renewal. The device is very simple, consisting only of a vulcanized washer, located in the top of the stuffing box and kept in position by spring compression, which fully compensates for the wear on the washer. These valves open and close by turning the lever handle one-half turn. The quick opening and closing feature will be appreciated by users, who have operated old style radiator valves. The lever handle may be operated by the foot, as well as by the hand.

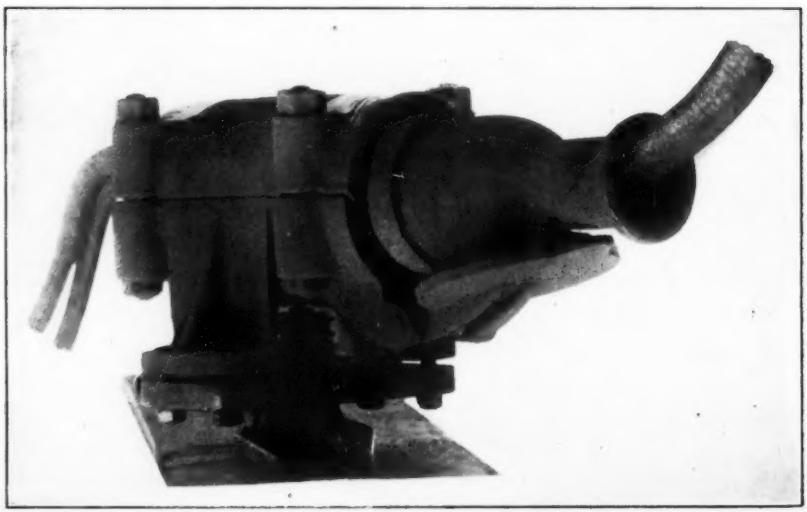
The construction of these valves is such, that when closed the discs bear on the seats very tightly, and the valve is locked in place until released. The bonnets are interchangeable with the bonnets of Crane

regular radiator valves. This is of advantage to the user, as he may, at any time, equip his old valves with these new improvements. Further information will be furnished by the manufacturers, Crane Co., Chicago.

Westinghouse Charging Receptacle.

THE extensive use of electrically operated vehicles and the varied application of storage batteries for train lighting, small electric locomotives, storage battery cars, etc., has created a demand for convenient and durable accessories, one of the most important being a charging receptacle that will withstand hard usage and can be handled without danger of short-circuiting the line when inserting or removing the plug. With this idea in mind the Westinghouse Electric and Manufacturing Company has developed and placed upon the market a charging receptacle designed to meet the most rigid requirements. It consists of a cast metal case, circular in form. Within the case are suitably mounted contacts for receiving the plug. A hinged lid at one end, held normally closed by a coiled spring, affords access to the interior. The receptacle being entirely enclosed effectually protects it from dirt and water. The plug and contacts within the receptacle are so designed that it is impossible to cause a short circuit when inserting or withdrawing the plug.

The receptable may be provided with a swivel attachment, conforming to standard railway practice, which is a decided advantage, as it admits the pulling out of the plug when the vehicle or car starts, the receptacle swinging in line with the cables, and allowing the plug to pull out without danger of breaking the cables or contacts. The charging plug shown in the accompanying illustration is intended for use with the charging receptacle. It is furnished with or without cables as desired.



NEWS SUPPLEMENT

The Engineering Magazine—January, 1906.

Personal.

—George H. Daniels, for many years general passenger agent of the New York Central R. R., has been appointed advertising manager of all their lines.

—H. M. Baxter, who was connected for several years with the Westinghouse Electric and Manufacturing Co., in the purchasing and advertising departments, has established an office in the Park Building, to handle the advertising appropriations of firms in the machinery and mechanical products business.

—A. E. Hoerman, who has been with Curtis & Co. Mfg. Co., St. Louis, for several years as chief engineer, has opened an office at 261 Broadway, New York, as manufacturers' agent and will make pneumatic machinery his specialty. He will represent Curtis & Co. Mfg. Co., Dayton Pneumatic Tool Co., Dayton, and F. F. Slocomb & Co., Wilmington, Del.

Industrial Notes.

—Holtzer-Cabot Electric Co., Brookline, Mass., have discontinued their New York office.

—The Hendrick Manufacturing Co., Carbondale, have recently placed Byram C. Guerin in charge of their New York office at 149 Broadway.

—In order to adequately care for their increasing business the American Blower Co., Detroit, are erecting a three-story addition to their plant.

—The St. Louis office of the Sullivan Machinery Co., P. F. Jarvis, manager, has moved into larger quarters in the Missouri Trust Building.

—Goldschmidt Thermit Co., New York, have reprinted, in pamphlet form, a paper read before the Franklin Institute by E. Stutz on "Thermit Practice in America."

—The new office building for the Studebaker Bros. Mfg. Co., South Bend, Ind., is to be heated and ventilated by a fan system, the apparatus being furnished by B. F. Sturtevant Co., Boston.

—Jeffrey Manufacturing Co., Columbus, have recently established a New England branch with offices in the Oliver Building, Boston. H. C. Freeman, for many years with the home office at Columbus, is the engineer in charge.

—Erie Railroad has issued a pamphlet giving a list of the manufacturing plants that have located on their line during the fiscal year ending June 30, 1905. It also contains views showing some plants in course of erection.

—Kenny Electrical Mfg. Co., New York, have issued a little booklet entitled "Electricity in Plain Language" written for the non-technical. Contains definitions of volts, ohms, amperes, watts and many other electrical terms.

—The wet machine room, grinding room and tempering building of the Spanish Pulp and Paper Co., Espanola, Ont., are to be equipped by the B. F. Sturtevant Co., Boston, with a complete blower, heating and ventilating system.

—Keuffel & Esser Co., New York, state that the recent fire at their works was confined to several annex buildings and did not in any way damage the main buildings. No serious interruption of business is anticipated on account of the fire.

—"The Value of an Appraisal" is the title of a pretty little booklet issued by the Everett Audit Co., Chicago, describing very briefly what their appraisal comprises. Is gotten up in a very tasty manner and is a strong piece of literature on appraising.

—The Curtis & Curtis Co., Bridgeport, manufacturers of pipe cutting and threading machinery, have just opened a store at 60 Centre street, New York, where a full line of their pipe cutting and threading machines will be on exhibit and can be seen in operation.

—Newport Water Works, Newport, R. I., has awarded contracts for a vertical, triple expansion, crank and fly wheel pumping engine to the Allis-Chalmers Co., Milwaukee. The engine will have a daily capacity of 6,000,000 U. S. gallons against a head of 190 feet.

—Three centrifugal pumps, each having a capacity of ten million gallons daily, for the Massapequa Pumping Station, Borough of Brooklyn Water Works, have been recently contracted for with the Allis-Chalmers Co., Milwaukee. The pumps will be driven by vertical cross compound engines.

—The Iola Portland Cement Co., Iola, Kansas, has recently placed an order with The Westinghouse Machine Co., East Pittsburg, for three 500 horse power horizontal double acting gas engines and one 125 horse power vertical single acting gas engine to increase the capacity of their already large gas power plant.

—The Westinghouse Electric & Mfg. Co. have just perfected a portable pipe thawing transformer of 5 kilowatt capacity, also a choke coil to work in connection with standard 15 to 20 kilowatt lighting or power transformers, thus making standard capacity transformers available for thawing purposes in winter.

—Chas. C. Moore & Co., San Francisco, has issued a pamphlet on the economy of steam power plants using oil fuel; being a reprint from *The Journal of Electricity, Power and Gas.* It explains in detail the economies that can be expected in modern steam power plants using oil fuel under Pacific Coast conditions.

—The 30 stall roundhouse of the Intercolonial Railway, Truro, N. S., is being equipped by the B. F. Sturtevant Co., Boston, with a complete heating and ventilating system especially designed for the rapid thawing out of engines. An induced draft apparatus is also being furnished for the boiler plant.

—The Robins Conveying Belt Co., New York, has recently secured the contract from John R. White & Sons, Providence, covering hoisting machinery, belt conveyors and cable railroads. Among the other work now being completed by the Robins Company is the manufacture of belt conveyors for the Blaisdell Co., Los Angeles, and for the Carvin Mines of France.

—The Metropolitan Water and Sewerage Board of Boston has recently awarded the contracts for the Arlington Water Works Station to the Allis-Chalmers Co., Milwaukee. The equipment to be furnished is a horizontal, compound, condensing pumping engine, having a capacity of one and one-half million U. S. gallons in 24 hours against a head of 290 feet.

—By the will of the late Stephen Salisbury the Worcester Polytechnic Institute receives a bequest of $200,000. This money comes without restrictions of any kind on the part of the testator. In addition to this bequest Mr. Salisbury, at the time of his resignation a few weeks ago from the presidency of the Board of Trustees, made an additional gift to the Institute of $100,000, to be paid immediately.

—A steam railroad running from MacKey's Ferry to Beaufort, N. C., will be built for the Virginia and Carolina Coast Railway Co. This road will extend a total length of approximately 120 miles. The contract has been awarded to J. G. White & Co., New York, who will do all the clearing, grading and track laying work as well as the building of steel bridges and viaducts.

—The Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., report among other orders recently secured is a contract to supply a large part of the machinery for the new 250 ton mixer, which the Republic Iron & Steel Co. are installing at Youngstown, Ohio. During the past two weeks they have booked orders for the following sizes of the Wagner cold saws: 1-50 inches; 4-40 inches; 4-26 inches; 6-18 inches; and 1-14 inches.

—The Rail Joint Co. is the corporate name of the company recently organized under the Laws of the State of New York, and has acquired the business and property of the Continuous Rail Joint Co. of America, the Weber Railway Joint Manufacturing Co. and the Independent Railroad Supply Co., and will carry on the business of the three companies substantially as it has been conducted in the past, with offices at 29 West 34th street, New York.

—G. K. Hooper, New York, has just completed plans for remodeling and enlarging the foundry of Gould & Eberhardt, tool makers, Newark, N. J., and has under way for the same concern, plans for new office building, forge shop, and men's toilet room. Mr. Hooper is also engaged in cost reduction work in the plant of the Weir Frog Co., Cincinnati, and has an important

commission relating to his personal investments for I. T. Bush, president of the Bush Terminal Co., New York.

—Among recent contracts for heating and ventilating equipment placed with the B. F. Sturtevant Co., Boston, are included those for the National Tube Co., McKeesport, Pa., for rolling mills and machine shop, for the Fairbanks Morse-Canadian Mfg. Co., Toronto, Ont., including separate apparatus for machine shop, blacksmith shop and foundry; for Brown & Sharpe Mfg. Co., Providence; for Pressed Steel Car Co., McKees Rocks, Pa., for car paint shop; and for a similar shop at the Allegheny, Pa., plant of the same company.

—The city of Alpena, Mich., which recently voted an issue of bonds to defray the cost of a municipal lighting plant, has contracted with Allis-Chalmers Co., Milwaukee, for the complete electrical and power equipment. This consists of a 60 cycle Bullock alternating current generator, normal capacity 150 kilowatts, direct connected to a Reynolds-Corliss cross compound heavy duty engine; an exciter unit; jet condenser; switchboards; sub-station apparatus, and equipment for 100 arc lamps connected in series.

—Burnham-Hitchings-Pierson Co., New York, have installed sash operating devices in the power plants, car sheds, etc., in connection with the new electrical equipment of the Long Island Railroad. Among recent installations and those under way are all the Pennsylvania car shops and roundhouses on their lines east of Pittsburg and the Babcock & Wilcox new plant at Bayonne, N. J. An interesting feature in connection with the latter installation is the fact that the windows on each side of the building are operated from one central point and by one hand wheel.

—The interests controlling the Bedford Quarries Co., Bedford, Ind., and the Ohio Quarries Co., North Amherst, O., are planning to largely increase the output of their limestone and sandstone properties at the above points. The new equipment required at the quarries next year will include 18 Sullivan stone channeling machines, which have just been ordered through the Sullivan Machinery Co., Bloomington, Ind. These machines are of the class "Y" rigid head type, with boiler. The Consolidated Stone Co. has also ordered four of the new class "Y" Sullivan oolitic type channelers with 8 inch cylinders, for use at its quarries at Bloomington and Bedford. The New York office of the Sullivan Machinery Co. has also secured from F. A. Maselli & Co. an order for two class Y-8 channelers and several rock drills, for use at Rochester, N. Y., on the Erie Canal improvements.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Ball Bearings.

STANDARD ROLLER BEARING CO., Philadelphia. —Catalogue No. 12 containing full information, prices and illustrations of ball and roller bearings. 4¼ by 7 in.; pp. 90.

Boilers.

INTERNATIONAL BOILER WORKS CO., East Stroudsburg, Pa.—Well-printed catalogue containing an illustrated description of their boilers, together with many tables giving much valuable information. 6 by 9 in.; pp. 40.

Coal Handling Machinery.

JEFFREY MANUFACTURING CO., Columbus.—Catalogue No. 20 illustrating and describing machinery specially designed for handling coal at the mines. Is well printed and finely illustrated. 6 by 9 in.; pp. 142.

Compressed Air.

INGERSOLL-RAND CO., New York.—"Water Lifted by Compressed Air" is the title of Catalogue No. 73 issued by this company. It conveys a general idea of the possibilities of compressed air for pumping water and outlines the general conditions to be met. Contains many illustrations showing the air lift in actual operation. 6 by 9 in.; pp. 100.

Elevators.

OTIS ELEVATOR CO., New York.—Catalogue illustrating and describing elevating machinery and apparatus manufactured by this company. 8 by 9 in,; pp. 64.

Electric Equipment.

GENERAL ELECTRIC Co., Schenectady, N. Y.—Bulletins Nos. 4423 to 4427 inclusive, illustrating and describing switchboards; incandescent lamps for projectors, headlights, etc.; oil break switches; generators; and governors.

Hoisting Engines.

C. W. HUNT Co., West New Brighton, N. Y.—Catalogue No. 058 containing an illustrated description of steam hoisting engines especially designed for heavy duty in continuous service. 7 by 9 in.; pp. 32. Also catalogue No. 0510 illustrating and describing their automatic railways. Contains many views showing recent installations. 7 by 9 in.; pp. 36.

Indicators.

AMERICAN STEAM GAUGE & VALVE MFG. Co., Boston.—Folder illustrating and describing the American Thompson improved indicator with the new improved detent motion.

Locomotives.

AMERICAN LOCOMOTIVE Co., New York.—Catalogue containing illustrations and description of the Mallet articulated compound locomotive, together with many tables giving much valuable data. 9 by 6 in.; pp. 32. Also a catalogue describing the Cole four-cylinder balanced compound locomotive. To illustrate the chief details of construction the New York Central locomotive No. 3000 is selected for description. Line engravings show elevations and sections of the locomotive as a whole, the construction of the frames, cylinders, crank-axles and valves. Also contains comments from the technical press concerning this type of locomotive. 9 by 6 in.; pp. 36.

Milling Machines.

NEWTON MACHINE TOOL WORKS, Philadelphia.—Catalogue No. 42 illustrating and describing the horizontal slab milling machines. 6 by 9 in.; pp. 24.

Motors.

NATIONAL ELECTRIC Co., Milwaukee.—Bulletin No. 359 illustrating and describing polyphase induction motors. Bulletin No. 363 treats of stationary and portable motor-driven air compressors. 7 by 10 in.; pp. 8.

NORTHERN ELECTRICAL MANUFACTURING Co., Madison, Wis.—Leaflet No. 148, showing some applications of motor drive in hoisting work. The leaflet reveals the special adaptability of the various types of motors for hoisting service. 3½ by 6¼ in.; pp. 4.

Ore Sampling Machinery.

ALLIS-CHALMERS Co., Milwaukee.—Catalogue No. 127 treating of sampling mills, ore breakers, crushing rolls, sample grinders, etc. 8 by 10½ in.; pp. 54. Bulletins 1405, 6 and 7 illustrate and describe portable rock crushing plants, forged steel balls and Bennett's pouring spoon respectively.

Pipe.

MCWANE PIPE WORKS, Lynchburg, Va.—Unique catalogue illustrating and describing their cast iron water and gas pipe and water works supplies of all descriptions. Also contains many tables giving weights and dimensions. 9 by 3½ in.; pp. 26.

Pneumatic Tools.

CHICAGO PNEUMATIC TOOL Co., Chicago.—Catalogue No. 17, covering their entire line of pneumatic tools and appliances, together with a list of prices for repair parts. Finely illustrated and well printed. 6 by 9 in.; pp. 196.

Rock Drills.

CHICAGO PNEUMATIC TOOL Co., Chicago.—Catalogue No. 18, covering their line of rock drills for quarry and mining work in general. Air compressors are also treated. 6 by 9 in.; pp. 66.

SULLIVAN MACHINERY Co., Chicago.—Catalogue No. 51 entitled "The Excavation of Rock by Machinery" containing an illustrated description of the Sullivan rock drills and stone channeling machines, together with tables giving weights and specifications. 6 by 9 in.; pp. 112.

Slide Rules.

EUGENE DIETZGEN Co., Chicago.—Booklet treating of the theory and practical application of the Mannheim and Multiplex slide rules. Contains much information of value to engineers. 4 by 7 in.; pp. 60.

Steam Engines.

WESTINGHOUSE MACHINE Co., Pittsburg.—Catalogue, printed in two colors, containing an illustrated description of their standard engines. 6 by 9 in.; pp. 36.

Steam Turbines.

GENERAL ELECTRIC Co., Schenectady, N. Y.—Well-printed catalogue containing illustrations showing some representative installations of Curtis steam turbines, which are briefly described in the titles. 8 by 10½ in.; pp. 32.

Turret Machines.

GEORGE G. PRENTICE & Co., New Haven.—Well-printed catalogue illustrating and describing multiple spindle automatic turret machines. Also contains tables giving dimensions and capacities of the same. 6 by 9 in.; pp. 20.

Valves.

MASON REGULATOR Co., Boston.—Catalogue containing a general description of the Mason reducing valve, together with illustrations showing general and sectional views of the valve. 6 by 9 in.; pp. 56. Also price list and catalogue, pocket size, of their steam regulating devices and steam pumps.

IMPROVED MACHINERY

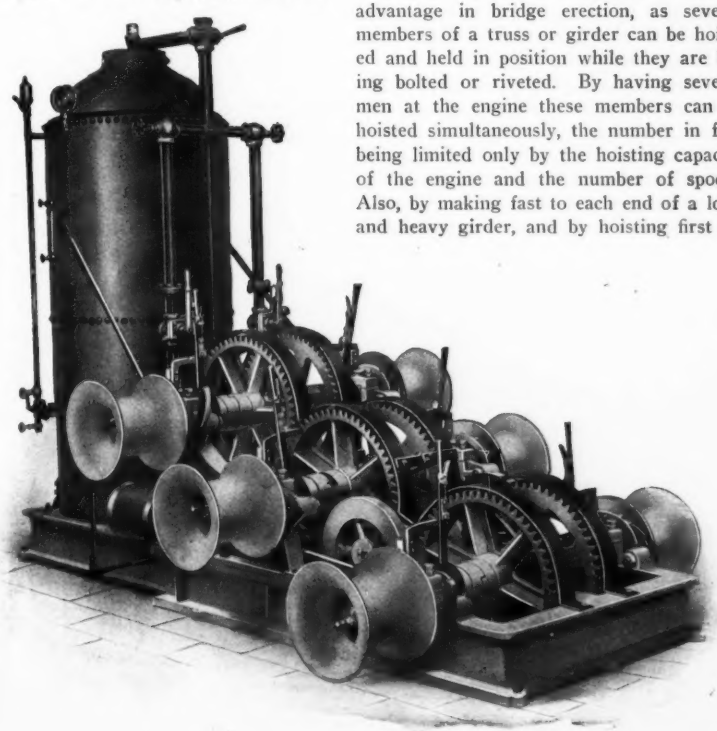
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

Lidgerwood Erecting Machine.

WE illustrate in the accompanying engraving the latest type of Lidgerwood hoisting engine, specially designed and largely used in bridge erection work, as well as in the construction of steel framework buildings. It is equipped with winches or spools instead of drums, on account of the large amount of rope usually to be wound in this class of work, and the fact that with the winch or spool the quantity can be taken care of is practically unlimited.

The spools are all keyed fast to the shafts, which are independent and supported by a central bearing. Each spool-shaft has its own gear running loose on the shaft, and fitted with a jaw clutch. The jaw clutches are of the Lidgerwood spiral type, and can be thrown in at any position by small hand levers having thumb-latches, engaging with notches on the quadrants, so that when the clutches are thrown in they cannot come out, and when thrown out there is no danger of their accidentally becoming engaged. The absolute independence of the spools enables the engine to be operated to great advantage in bridge erection, as several members of a truss or girder can be hoisted and held in position while they are being bolted or riveted. By having several men at the engine these members can be hoisted simultaneously, the number in fact being limited only by the hoisting capacity of the engine and the number of spools. Also, by making fast to each end of a long and heavy girder, and by hoisting first on



one end and then on the other, a much greater weight can be handled than by means of a drum hoist. The tackle can also be multiplied as much as desired, since any amount of rope can be wound on the spools.

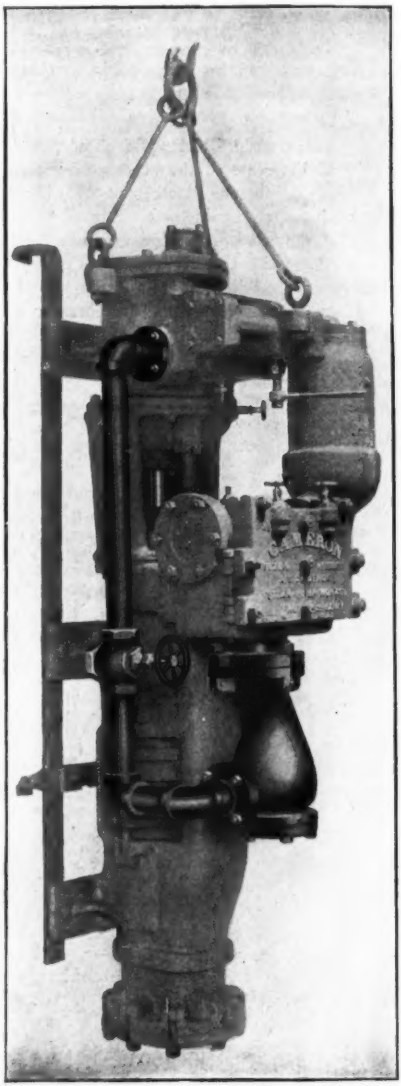
This engine is especially well proportioned for the severe hoisting duty it has to perform. It will be noticed that the bed-plate is in one piece, and widened in front so that the working parts of the engine are all inside the side frames of the engine. This leaves the winches clear so they can be operated without danger to the man handling the lines. The shaft bearings are wide, and the shafts themselves are unusually large and of the best hammered steel, to withstand the strain due to handling heavy weights on the overhanging spools. The gearing is extra strong and heavy, and the engine can be operated from either side. An important element in the success of this engine lies in the form of the spool, which is especially adapted to the class of work for which the engine is designed to be used. If desired, the engine can be equipped so as to be self-propelling in either direction.

Condenser for Sinking Pumps.

THE disposition of exhaust steam from mine pumps is often a serious problem. The use of long piping to carry off the exhaust is always expensive and inconvenient when the positions of the pumps must be changed. The Cameron Steam Pump Works are applying to their sinking pumps, when required, a method of steam condensation described in the accompanying illustration.

The darker portion shows the condenser, together with the exhaust pipe leading thereto, and directly bolted to the water valve chest, which makes a very compact arrangement without causing any resistance to the free inflow of water, while at the same time it is exceedingly effective in taking care of the exhaust steam by condensing it, and permitting it to enter the pump, as water, through the suction opening, from which it is discharged to the surface.

The constant flow of water through the suction piping connected to the bottom of the condenser will naturally cool the bronze sleeve which is arranged within the condenser chamber; so that when the exhaust steam comes in contact with the cool surface, part of it will immediately be condensed, and the remainder, passing through the annular opening, will also be condensed



after mixing with the water passing through the suction.

It also has the additional advantage of relieving the steam piston of back pressure, as a partial vacuum is formed proportionate to the height of suction lift. It is necessary that the water cylinder be fully charged before the exhaust steam is turned into the condenser, by allowing the pump to exhaust into the atmosphere until it has become filled with water, then the three-way valve may be turned and the exhaust steam admitted to the condenser, but it should never be allowed to enter except in combination with the water. In some cases automatic floats are arranged to stop the pumps when the water supply is down.

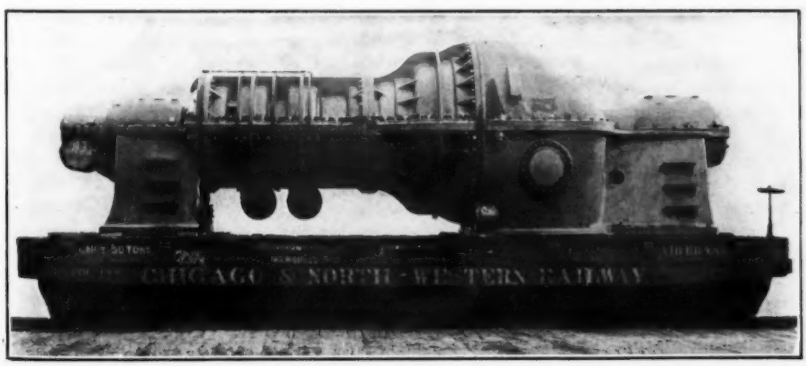
The Cameron Steam Pump Works, foot of East 23rd street, New York, will furnish further details on request.

Steam Turbine for New Power House.

THE sixth of the huge power plants to be constructed for the Brooklyn Rapid Transit Co. will show, in some respects, a radical departure from the features usually found in stations where reciprocating engines are installed. Among the more important of these is the small floor space needed for the machinery. The engine room of the ordinary station requires sixty per cent. of the total ground space, and the boiler section forty per cent. In the new turbine plant, the turbine floor occupies but two-thirds the space required for the boilers. In other words, a turbine station of a given capacity requires only two-thirds of the ground room needed by a reciprocating engine station. The importance of this is at once apparent in localities where real estate is costly. It also means an equivalent saving in expense incurred for buildings. The new Williamsburg station, which has been erected near the bridge of the same name, is designed to accommodate a total of nine steam turbine and generator units, three of which are now being installed. One of the most interesting of these is the Allis-Chalmers 9,000 horse power unit. A view of the body of the turbine, as it appeared when loaded on a 36 foot flat-car, for shipment from the West Allis works of Allis-Chalmers Co. is shown in the illustration printed herewith.

The turbine is of the horizontal multiple expansion, all-around parallel flow type, generally known as the Parsons type, operating at 750 revolutions per minute. The generator is a Bullock alternating current machine built by the Allis-Chalmers Company at its Cincinnati works. It will carry twenty-five per cent. overload continuously and fifty per cent. overload for three hours with but small temperature rise.

A noteworthy feature in the construction of the Allis-Chalmers turbine is the blading; the blades are made of a special alloy and of such form and dimensions as will secure the highest economy. The individual blades are mounted in groups, each group forming one-half of a circular row. The inner ends of the blades are swaged, firmly secured in accurately spaced slots in foundation rings and riveted in slots in their respective channel shaped shrouds. The blade rings are secured by special calking strips in accurately machined grooves



in the cylinder and rotor, thus absolutely insuring against throwing out due to centrifugal force. The channel shaped shroud secures the blades in a substantial manner at the proper angle and spacing and eliminates the danger of stripping, permitting the turbine to be safely operated with a minimum radial clearance. This special design of blading does away with hand-work. The machine construction insures great strength, perfect alignment, and uniformity in the spacing of the blades.

Having adopted the proper working principle, the efficiency of a steam turbine depends on the accuracy of angles, spacing and form of blades. All of these factors are obtained in the construction of the Allis-Chalmers turbine. The lubricating arrangement is free from complications, complete and efficient. It is equipped with a direct acting steam pump for use on starting up the turbine. The turbine and generator rotors are direct-connectel by a flexible coupling, each being carried in two bearings of the ball and socket type. The turbo-generating unit measures approximately 47 feet in length, over all, 13 feet 3 inches in width, and 11 feet 6 inches in height above the engine room floor. Its height above the foundation is scarcely more than that of the low pressure cylinder of a reciprocating engine, of equal capacity, above the upper platform, and such cylinders are frequently more than thirty feet above the engine foundations.

Important Movement in Advertising.

THE creation of a general advertising department for the New York Central lines, and the placing in charge of that department the veteran railroad advertiser, George H. Daniels, for nearly twenty years the General Passenger Agent of the New York Central Railroad, marks a departure in railroading.

The New York Central lines are the first great system to create an advertising department which covers all the railways in their system.

Some idea of the importance of this new department can be had when it is understood that it will control the general advertising in America and in foreign countries of the New York Central, Boston and Albany, Lake Shore and Michigan Southern, Michigan Central, Cleveland, Cincinnati, Chicago and St. Louis, Rutland, and Lake Erie and Western railways and their leased lines, having their western terminals at Chicago, St. Louis and Cincinnati and their eastern terminals at New York, Boston and Montreal, and embracing more than twelve thousand miles of track.

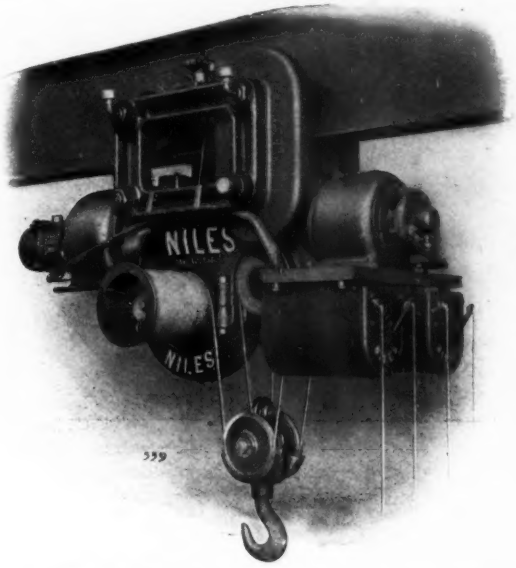
Mr. Daniels has for many years been a firm believer in newspaper and magazine advertising, and, therefore, the organization of the general advertising department of the New York Central lines is of importance to every legitimate publication in America, daily, weekly or monthly.

Niles Electric Traveling Hoist.

ELECTRIC traveling hoists have now passed the experimental stage and their use is extending so rapidly that greater care is given in their design to the question of durability. The new Niles electric traveling hoist is designed for hard, continuous service. As may be seen in the illustration the hoist is of compact design, and is self-contained in one heavy cast-iron frame to which the motors are attached end on. The power is transmitted directly from the armature shaft to the drum shaf through one train of worm and worm-wheel gears. The traversing mechanism is also driven through one train of worm and worm-wheel gears, similar to the hoisting mechanism, except that, when the trolley is arranged to run on a single I-beam, a double set of transmission gears are used. All the mechanism is enclosed in oil and dust-proof casings, and is absolutely noiseless in operation. In addition to the braking effect obtained by the use of the worm and worm-wheel, a powerful electric brake is attached to the hoist motor. These hoists, when mounted on a traveling bridge may be used as small-capacity cranes. When used as cranes, the hoists are arranged to run between the two I-beams or channels of the bridge, and the controllers for raising and lowering the hook and operating the traversing mechanism may be placed either on the hoist, on the bridge, and operated by cords from the floor, or in an operaor's cage attached to the bridge.

The Niles hoists are built in capacities of three-quarter to six tons and are usually

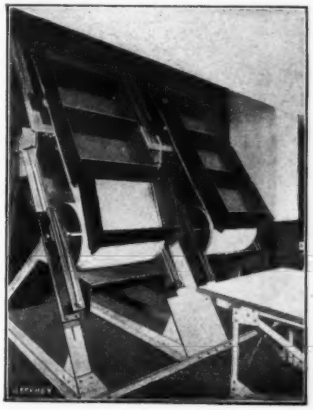
arranged to run on an I-beam track. They will run on straight and curved tracks, and are generally provided with a separate motor for traversing, but if desired, hand traverse may be furnished, or all the traversing mechanism may be omitted and the trolley moved along the track by pushing on the load. The increased service of the electric traverse, however, much more than compensates for the slight additional cost.



The Niles-Bement-Pond Co., New York, will send full description on request.

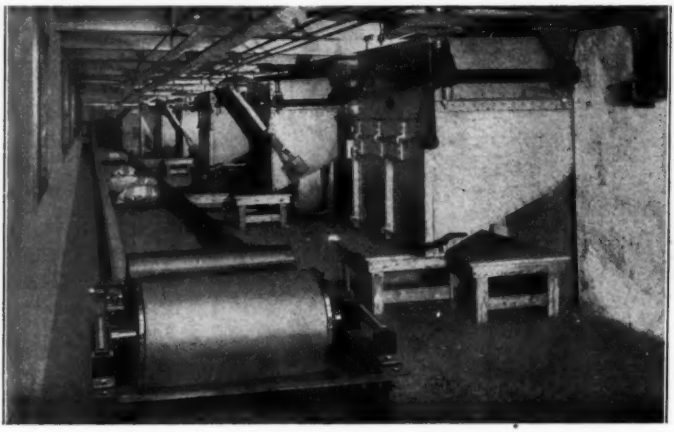
Mail Handling at Chicago.

THE new Chicago postoffice has been equipped with the most improved mail-handling conveying system ever installed in any postal station. The machinery, consisting of conveyors and elevators, was designed and installed by the Jeffrey Mfg. Company, the machinery being built in their shops at Columbus, Ohio. On the sidewalk along Dearborn street thirteen ornamental iron mail boxes have been erected, under which are hung steel weigh hoppers, in the basement of the building, each having a capacity of one ton of mail. The process of handling the mail on this side of the building is as follows: Wagons containing the mail in bags, sacks and pouches, back up to the mail boxes, the doors of which are opened from below upon a signal from the driver, which rings a bell and lights an electric lamp at the hopper to be weighed. The bags are thrown through the street door of the box into the weigh hoppers. The weight of the mail is recorded by a recording beam scale and the sacks are then dumped on a horizontal 36″ belt conveyor running under the line of the mail boxes. This conveyor delivers the bag to an inclined belt conveyor running at high speed, which separates the mail sacks and delivers them into a 48″ belt conveyor traveling at a right angle to the 36″ conveyors. The 48″ conveyor carries the bags to the foot end of the elevators and discharges automatically into the elevator boot. The elevators consist of buckets 40″ wide by 4′ 6″ long, hung on a double strand of 24″ pitch roller chain, running at a speed of 60 feet per minute.

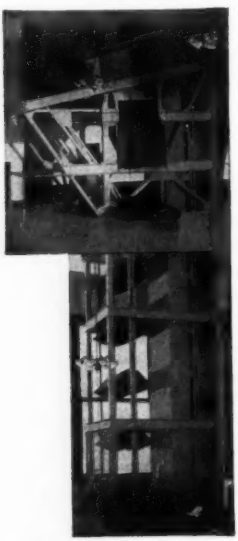


These elevators take the mail bags and pouches, as well as carrier's satchels, up to the second floor of the building and discharge same on the floor, where they are

picked up by the trucks and delivered to the different sorting points of the distributing floor, going directly to the various "States."



All belt conveyors of this system run on ball bearing rolls and are driven by chains from direct current electric motors.



The elevators are geared directly to their motors.

There are three independent conveyor systems, as described above, on the east side of the building, each consisting of 3 belt conveyors and one elevator. On the other side of the building the conveying system consists of four bucket elevators, which are loaded by hand from the mailing platform in the basement driveway of the building. Two of these elevators discharge on the first floor, while the other two discharge the mail on the second floor. These elevators consist of steel buckets 29″ wide by 4′ 6″ long, hung on double strand of 24″ pitch roller chain and are spaced four feet apart. From the tunnel system of the city, which will bring the mail from all of the depots, and also a large part of the newspaper and commercial mail, a separate conveyor set is now being installed. This consists of a belt conveyor, running between two tracks of the underground tunnel system for 140 feet, then rising to a chamber over the tunnel system and under the driveway of the postoffice. In this chamber the bags of mail are automatically reloaded onto a five foot belt conveyor, which discharges the mail onto the receiving floor of the postoffice. The enormous amount of mail coming into the postoffice by the underground tunnels will be appreciated when the capacity of these conveyors is considered: the system must discharge at some hours of the day 300 bags per minute.

Another conveying system running from the first floor to the second floor consists of two inclined belt conveyors with steel pans riveted to the belt, discharging loose letters directly to a sorting table. These

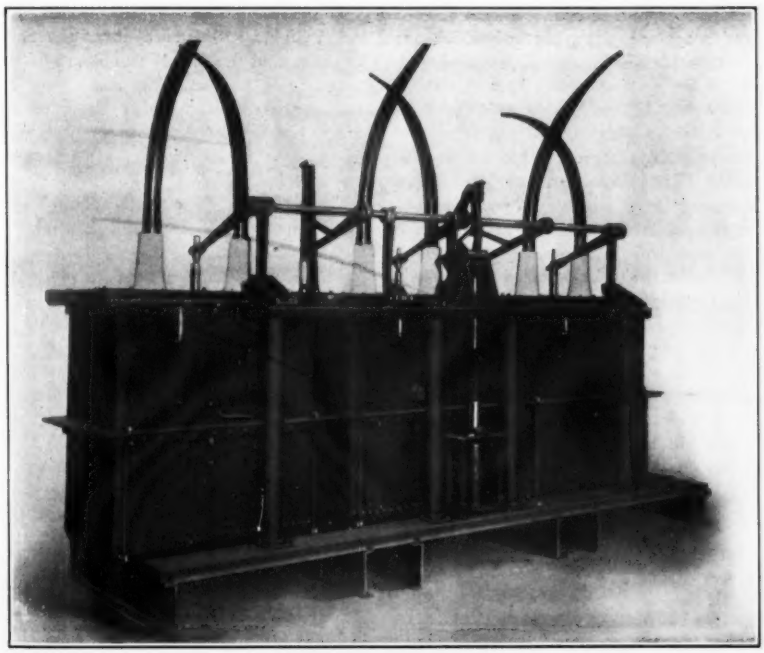
conveyors receive all the loose mail, packages and pouches delivered by the public through the letter drops and windows of the city division and discharge the mail on tables on the second floor, where it is sorted and distributed in the proper State subdivisions.

The money order division has also been provided with a belt conveying system to carry money order applications from the clerks' windows to the cashier's desk. This conveyor consists of a rubber belt with longitudinal corrugations to prevent the sheets of paper sticking to the belt; the machinery is concealed under the counter on which the money orders are made out.

Oil Circuit Breaker.

THE breaker shown in the illustration was designed by the Westinghouse Electric & Manufacturing Company primarily for the Ontario Power Company's work. It is intended to handle energy up to 60,000 horse power per three-phase circuit, and will open a circuit under any conditions of overload or short circuit which may occur with a power house capable of delivering 200,000 horse power. The insulation to ground and between terminals is designed to withstand a break-down test of 150,000 volts, and the insulation between poles is twice that amount, since the poles are electrically separate.

The three poles of the switch are closed together by means of a toggle joint operated by a single direct-pull solenoid. The switch is held in a closed position by the toggle being carried just beyond the center, and is tripped out by the tripping coil armature striking this toggle and knocking it backward, allowing the switch to open by gravity. Each pole of the switch gives a double break, each break being approximately 17 inches. The closing magnets require approximately 5,000 watts direct current, while the tripping magnets require about 300 watts. The oil tanks, of which there are three, are made of boiler iron lined with an insulating material, with barriers interposed between the stationary contacts. The contact parts are of their standard type C construction, having renewable arcing tips and contacts. The leads, with their insulation and the upper



porcelain insulators, may be readily removed from the switch, giving access to the contact parts for inspection and repairs. The top covers of the tanks are made of treated soapstone slabs, part of which are also removable. Each tank is provided with an oil drain opening in the bottom and an overflow just above the normal oil level. These openings are provided with standard 3-inch pipe flange threads, but no pipe is provided. Each tank has an oil level gauge and requires approximately 160 gallons of oil.

The total weight of each 3-pole switch complete, the tanks being filled with oil, is about 15,000 pounds. The oil alone weighs 4,000 pounds.

A 2-pole double-throw indicating switch is provided upon each 3-pole switch for use in connection with the controlling and indicating devices. The circuit breaker is not automatic in itself, an overload relay operated from series transformers being necessary.

Helliwell Skylights.

THE American Skylight and Iron Works, 221 Randolph avenue, Jersey City, N. J., builders of the improved Helliwell system of continuous puttyless skylights and glass roofs, have just completed an important contract for the United States Government.

The contract was for the removal of the old skylights and framing over the Senate Chamber and the hall of the House of Representatives, and substituting therefor new and improved, as well as extended skylights. In competition with other types of skylights, the Helliwell puttyless system was selected.

These skylights contain about 15,000 square feet. The American Skylight and Iron Works removed the old framing and erected a new frame to support all the new work, using in all about thirty tons of structural steel. The glass used was ⅜-inch wireglass, laid in lights 20 by 74 inches The time required to fill the contract was about two months. Other work of the same character in Washington is now being planned.

The Helliwell system was adopted for Pier No. 3 of the North German Lloyd Steamship Co., at Hoboken, the new shops of the Lackawanna Railroad at Kingsland, and for the new buildings of the American Hoist and Derrick Co., St. Paul. The contract for the new Lackawanna shops called for about 5,000 square feet of skylights.

NEWS SUPPLEMENT

The Engineering Magazine—February, 1906.

Personal.

—J. W. Shone, secretary of the Century Cement Machine Co., died recently at his home in Rochester.

—Kendall Banning, formerly managing editor of *System*, has been admitted into the firm of Bruce & Johnston, advertising engineers, New York, and the firm name has been changed to Bruce & Manning.

—W. M. Grosvenor, formerly with the General Chemical Co., and for the past year general superintendent of The Contact Process Co., is now identified with the Geo. F. Westcott Co., Buffalo, as treasurer.

—F. B. Davant, formerly general superintendent of the Glover Locomotive and Machine Works, Marietta, Ga., is engaged in the practice of mechanical engineering with offices at 703 Prudential Building, Atlanta, Ga.

—Hugo Diemer, who has for many years been identified with betterment work in connection with some of the most important shops in the country, has opened formal office headquarters in the Commercial Club Building, Indianapolis. He will practice as consulting engineer in the field of "Industrial" or "Production" engineering.

Industrial Notes.

—B. M. Jones & Co., Boston, has become incorporated under the name and style of B. M. Jones & Co., Incorporated.

—The Ashton Valve Co., Boston, are sending out to the engineering fraternity and trade in general a very pretty calendar.

—Robb-Mumford Boiler Co. announces that it has moved from Cambridge to its new plant at South Framingham, Mass.

—The recent fire at the works of F. E. Myers & Bro., Ashland, Ohio, was confined entirely to their storage buildings. The factory and material were saved.

—The Salt Lake City office of the Allis-Chalmers Co., formerly located at 209 S. W. Temple street, has been removed to the Dooly Building.

—The Robins Conveying Belt Co., New York, has recently opened an office at 749 Railway Exchange Building, Chicago, Ill. C. Kemble Baldwin, the chief engineer of the company, is in charge of this office.

Miller-Collins Co., New York, contracting engineers, held their first annual dinner at the Engineers' Club on December 30th, which was attended by the entire office and field staff of the company.

—The Chicago Pneumatic Tool Co., Chicago, have been awarded the gold medal at Liege, covering pneumatic tools and appliances, and the silver medal for Franklin air compressors.

—The Standard Roller Bearing Co., Philadelphia, has just started the erection of a brass and iron foundry 60 x 125 feet, two stories in height. Their crucible steel casting plant has been started in operation, the size of this building being 60 x 95 feet.

—Warren Webster & Co., Camden, N. J., have issued a vest pocket diary which is arranged in very convenient form, and which contains, besides the blank pages for memoranda, accounts and addresses, a great deal of information in compact shape.

—American Blower Co., Detroit, report orders for outfits for heating and ventilating some 50 schools and other public buildings, between 30 and 40 manufacturing buildings, and a large number of dryers for brick, lumber and other materials.

—P. Hollingsworth Morris, Philadelphia, announces that he has admitted his brother A. Saunders Morris, formerly with the Westinghouse Electric & Manufacturing Co., to partnership and that the firm hereafter will be known as P. H. & A. S. Morris.

—American Stoker Co., Erie, Pa., has acquired from the McMyler Manufacturing Co., Cleveland, their chain grate stoker business which has been operated under the trade name of the Victor chain grate stoker. The acquisition includes patterns, patents, drawings and good will.

—The Ingersoll-Rand Co., New York, announce that they have secured exclusive control of the product of the Imperial Pneumatic Tool Co., with shops at Athens, Pa. The line of Imperial tools includes pneumatic hammers, drills, riveters, reamers, hoists and plug drills.

—The National-Acme Manufacturing Co., Cleveland, to more satisfactorily serve their increasing trade in the Middle and Northwestern States, has decided to open a warehouse in Chicago at an early date where a complete stock of set and cap screws and kindred goods will be carried. The exact location will be announced later.

—Among the more important sales of the White Star oil filters closed by the Pittsburgh Gage & Supply Co., Pittsburgh, were: 19 through Philadelphia and New York houses of the Vandyck-Churchill Co.; 6 through the Gregg Engineering Supply Co., Cincinnati; 4 through the Whitney Supply Co., New Orleans. One of the complete White Star oiling systems sold was a third one bought by the People's Power Co., Moline, Ill.

—The Engineering Agency, Chicago, is undergoing a thorough reorganization and expansion. At the last directors' meeting, A. G. Frost, formerly secretary and manager, was elected vice-president and treasurer. R. D. Smith was elected second vice-president and general manager and Paul W. Herring was elected secretary. It is the plan of the Agency to start offices immediately in Pittsburg, New York and Denver, besides the present offices in Chicago.

—Among the contracts that F. L. Smidth & Co., cement engineers and makers of cement machinery, New York, have recently taken is one for 17 of their large size tubemills for the Pacific Portland Cement Co., Cement, Cal., and another one for 24 kominuters and tubemills for the new plant at Fogelsville, Lehigh Co., Pa., of the Lehigh Portland Cement Co. Three additional kominuters are now being installed at the mill "B" plant of the Lehigh Company.

—Something superior to the old forms of tooth gearing for power transmission was necessary to keep pace with the forward strides made by high grade, high speed machinery during the past few years. To this end friction gearing has been perfected and the designing engineer now finds it a subject with which he must rub elbows every day. One of the best and clearest volumes which has ever dealt with this subject is entitled "Friction Transmission" and is published by the Rockwood Manufacturing Co., Indianapolis. Originally intended to advertise their own product and to demonstrate to owners, designers and operators of machinery the superiority of the Rockwood patent paper frictions it fills another mission as well, as it is full of valuable information, diagrams and tables by which the operating engineer and machinist can familiarize himself with a subject with which, if not already, he must soon become conversant.

—The Robins Conveying Belt Co., New York, has recently secured an order for a series of conveyors for ore bedding purposes for the Garfield Plant of the American Smelting & Refining Co. Among other orders now on hand is one from the Western Engineering & Construction Co., San Francisco, for a 34 inch conveyor to be installed on a gold dredge in the Oroville District. This conveyor will be equipped with the Robins new style five pulley troughing idlers. They have also received an order from the Pittsburgh Reduction Co. for a belt conveyor intended for their East St. Louis Works; a 30 inch conveyor for a gold dredge in the Oroville District, Cal. Among other orders on hand is one for a 24 inch conveyor and 18 inch belt conveyors from the Pratt & Whitney Co., Hartford, and for a mast and gaff rig from the Pawtucket Gas Light Co., Pawtucket, R. I.; from B. Altman & Co., New York, for conveyors for handling packages at their new store on Fifth avenue. One of the requirements of this conveyor system is that it will be operated without the least noise. Among other work that the Robins Company now has on hand is an order for a large system of conveyors for the Caucasus Copper Co., Russia, and an order from the Bethlehem Steel Co. for a belt conveyor for handling sand at their foundry at South Bethlehem, Pa.

—The Consolidated Engineering & Construction Co., New York, have opened offices in the rooms formerly occupied by the Syracuse Savings Bank, Syracuse. The

company takes contracts for any class of construction on any reasonable form of contract, but it has especially systematized its entire organization so that it may be placed as a unit at the disposal of an individual or corporation contemplating any piece of construction, whether it be a public building, a dam, or an entire manufacturing plant. The benefits derived from this method are that the owner gets the building completed as rapidly as consistent with good workmanship, gets workmanship consistent with the type of construction under consideration, and at a minimum of cost. They have secured some of the most important contracts recently awarded, among them being the Piper Building in Baltimore, the C. B. Alexander residence, New York, the Simmons Hardware Company's plant at Sioux City, a concrete dam 60 feet high, across the Saranac River, for the International Paper Co., and the Kursheedt Silk Mills in Brooklyn. The men interested in this company are W. E. Hamlin, late with the U. S. Engineers' Corps on construction work; J. Everett Polsey, head of the mill department; Ivan Kruger, chief engineer of the concrete department; J. R. Pierce, in charge of the construction department; J. F. Phelan and G. R. Kennedy.

To the Editor THE ENGINEERING MAGAZINE:—*Sir:*

In the spring of 1904 the engineer of our Transmission Rope Department read a paper before the New England Cotton Manufacturers' Association, showing the relative cost of rope, belt and electrical drives in cotton mills. This paper brought forth considerable criticism at the time, the most severe coming from partisans of electrical transmission. Our reply to this criticism was the following offer, which was printed in practically all of the technical and trade papers of the United States:

"The American Mfg. Co., of No. 65 Wall street, New York, will agree to furnish the necessary rope sheaves, rope, and driven head-shafts, for the main drive of any cotton mill using 500 horse power or more, developed at the mill site, at one-quarter the price for which any responsible company, furnishing electrical apparatus, will agree to install generators, motors, motor shafts, switchboard, wiring and other appliances necessary to transmit electrically the same power.

"Where the power is generated at a distance from the mill site, if the mill will install the central motor, The American Mfg. Co. will agree to distribute the power from same to the main line shafts, by means of rope drives, for half the cost of electrical apparatus to distribute the same power.

"This offer is made to any cotton, woolen, paper or similar mill in the United States."

It is nearly two years since this offer was made. So far, no manufacturer of electrical apparatus has come forward to take up the challenge. We wish now to repeat the offer, with the following addition:

"We will guarantee to any cotton, woolen, paper or similar mill using 500 horse power or more, a saving of 25 per cent. in fuel consumption in favor of rope drives over any electrical equipment that can be installed, the same engine being used for both transmissions.

"Further, in case we fail, we will remove our apparatus without expense to the mill owner, and pay a forfeit of $10,000 to cover loss and inconvenience to the company making the trial, provided any concern furnishing electrical appliances will take the other side of the proposition, and duplicate this offer."

THE AMERICAN MFG. CO.,
By W. F. Morgan.

NEW YORK, January 6, 1906.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Anti-Friction Metal.

A. ALLAN & SON, New York.—Folder showing miniature reproductions of interesting pages from their catalogue.

Bending Machines.

WALLACE SUPPLY. CO., Chicago.—Catalogue showing samples of work done on the different styles of angle bending machines, together with sizes and prices of each. Also contains numerous testimonial letters from various users. 6 by 9 in.; pp. 20.

Buckets.

BROWNING ENGINEERING CO., Cleveland.—Bulletins Nos. 21 and 22, illustrating and describing the various uses to which their buckets may be adapted. Also contains views showing the buckets in operation. 6 by 9 in.

Cables.

GENERAL ELECTRIC CO., Schenectady.—Pamphlet containing a summary of the advantages of varnished cambric cables, together with tables giving dimensions, prices, etc. 5¼ by 7¾ in.; pp. 36.

Concrete Building Blocks.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS, Philadelphia.—Bulletin No. 1

entitled "Concrete Building Blocks," by S. B. Newberry, treating of the manufacture of concrete building blocks, together with illustrations showing the many different styles of blocks now manufactured. 6 by 9 in.; pp. 32.

Coupling.

T. R. ALMOND MFG. CO., Brooklyn.—Small folder dealing with the Almond Coupling as a means of transmitting motion at right angles. 3¼ by 6 in.; pp. 6.

Generators.

ALLIS-CHALMERS CO., Milwaukee.—Bulletin No. 1048, issued by the electrical department, illustrating and describing Bullock alternating current generators, engine and fly-wheel types; Bulletin No. 1202, treating of the self-adjusting reliance clutch pulley; and Bulletin No. 1501 contains an illustrated description of the reliance Corliss engines, belted type. All three of the publications are well printed, in two colors, and contain many fine illustrations.

Heating and Ventilating Apparatus.

GREEN FUEL ECONOMIZER CO., Matteawan, N. Y.—Booklet illustrating and describing fans, blowers and exhausters for heating and ventilating, mechanical draft and other purposes. 3½ by 6 in.; pp. 16.

Hoisting Machinery.

SULLIVAN MACHINERY CO., Chicago.—Catalogue containing an illustrated description of their full line of hoisting machinery. Also contains tables giving much valuable information. 6 by 9 in.; pp. 32.

LIDGERWOOD MANUFACTURING CO., New York.—Large catalogue printed in two colors treating of hoisting engines, boilers, cableways, log hauling machinery, hoisting and conveying apparatus and ballast unloaders. 9½ by 11½ in.; pp. 168.

CROCKER-WHEELER CO., Ampere, N. J.—Bulletin No. 62, entitled "Electric Hoisting Machinery," illustrating and describing hoisting machinery, direct connected to electric motors. A variety of types of electric hoists, winches, capstans, etc., are shown, and the weights, dimensions and capacities are given in the bulletin. 7½ by 10 in.; pp. 8.

Industrial Railways.

ERNEST WIENER CO., New York.—Catalogue No. 36-G illustrating and describing industrial railways. Also contains tables and other data which should prove of interest to engineers, contractors, mine operators, shop superintendents, etc. 8 by 11 in.; pp. 48.

C. W. HUNT CO., West New Brighton, N. Y.—Catalogue No. 0511, treats of narrow gauge track and suitable cars for the handling of raw and finished materials. Contains illustrations of the different styles of cars manufactured, together with views showing some recent installations. 6 by 9 in.; pp. 64.

Planers and Shapers.

HAMILTON MACHINE TOOL CO., Hamilton, O.—Catalogue No. 5, containing an illustrated description of their planers and shapers, together with list of sizes. Engine lathes, upright drill presses and radial drills are also treated. 6 by 9 in.; pp. 80.

Power Pumps.

F. E. MYERS & BRO., Ashland, O.—Catalogue illustrating and describing the different styles of pumps manufactured by them. Also gives capacity and price of each. 6 by 9 in.; pp. 48.

Pump Governor.

IDEAL PUMP GOVERNOR CO., New York.—Catalogue containing a description of the Ideal pump governor, illustrated with line engravings. 9 by 6 in.; pp. 8.

Stamp Mills.

ALLIS-CHALMERS CO., Milwaukee.—Bulletin No. 1408, printed in two colors, illustrating and describing the Tremain steam stamp mill. The Gates rock and ore crusher is also treated, together with tables giving dimensions, weights, capacities and required power. 8 by 10½ in.; pp. 48.

Steam Specialties.

THE LUNKENHEIMER CO., Cincinnati.—Illustrated price list and catalogue for 1906, bound in cloth, of their steam specialties, comprising brass and iron valves, whistles, cocks, gauges, injectors, lubricators, oil pumps, oil and grease cups, etc. Section XV, devoted to tables and useful data, contains much information of value to engineers. 5 by 7 in.; pp. 472.

Tin Roofing.

MERCHANT & EVANS CO., Philadelphia.—Booklet entitled "Roofing Rules," a hand-book on sheet metals in building construction for architects, owners, engineers and builders. Is well printed in two colors and contains much valuable information. Also contains illustrations showing buildings on which their roofing has been applied and testimonial letters from users. 8 by 5½ in.; pp. 56.

Valve Gears.

AMERICAN LOCOMOTIVE CO., New York.—Pamphlet devoted to the application of Walschaert valve gear to large American locomotives. The pamphlet illustrates six large modern locomotives equipped with this gear, including the heaviest passenger, freight and switching locomotives ever built. Line engravings illustrate side elevations and cross sections of a number of designs, showing arrangement of the gear. 9 by 6 in.; pp. 44.

Water Wheels.

ABNER DOBLE CO., San Francisco.—Bulletin No. 7, containing general matter descriptive of the essential features of the Doble tangential water wheels. Illustrations of several different types of water wheels are followed by descriptions of some of the typical hydro-electric power plants in which their water wheels are operating. Also contains tables giving much valuable data to engineers interested in this work. 6 by 9 in.; pp. 100.

Wire Rope.

BRODERICK & BASCOM ROPE CO., St. Louis.—Well-printed catalogue treating of underground wire rope haulage as applied in the working of the Coal Valley Mining Co., at Sherrard and Cable, Ill. 9½ by 12½ in.; pp. 28.

IMPROVED MACHINERY

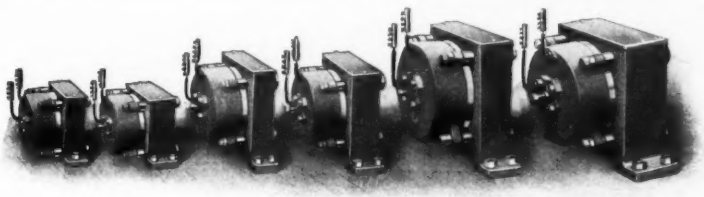
New Processes and Appliances

The matter here published is not paid for, nor can it be classed as advertising. But as the information is necessarily obtained from those who offer the appliances for sale, it is proper to say that the manufacturers, rather than ourselves, are responsible for the statements made.

A New Magnetic Brake.

THE Electric Controller & Supply Co., Cleveland, Ohio, are presenting to the trade their type "Q" brake for electrically driven machinery of 1 to 100 horse power. This brake embodies many new and desirable features, and promises to supplant the now universally used band brake or other types of brakes operated by a solenoid. The friction plates of type "Q" brakes are of metal which run in oil, thereby rendering the coefficient of friction absolutely constant under all conditions. In all cases where electrically driven machinery requires frequent stops and reversals, the facility and speed of handling material and the safety of the crane or other machinery employed depend upon the accuracy and reliability of the brake. The braking force of type "Q" brakes is always a definite and constant quantity, is applied axially and is balanced within the frame of the brake, allowing no blow or unbalanced thrust on the bearings of the motor. The brake is released by an electro-magnet through a diminutive air gap, which operates quickly with a comparatively small current and without any hammer blow. The brake force is always maximum and equally effective in either direction of rotation. The heat is carried away from the friction surfaces by the circulation of oil and is effectively radiated from the entire surface of the friction case. Adjustment of braking force can easily be made by simply screwing in or out the adjusting screw in the center of the spring cover. When the total amount of wear on all of the plates equals ¼", one new square plate can be placed in the friction case by removing the magnet case and two top studs. The brake is designed and always tested to release on one-half full load current of motor as a maximum. Due to the large pole area, the brake does not drop back until about one-tenth full load current, insuring a continued release of brake until the current is entirely cut off.

Weather protection is provided for by the coil being entirely enclosed, protecting it absolutely from mechanical injury, grounding or short circuiting. The working parts of the brake are also enclosed and waterproof, insuring equally good service under all conditions of weather. All parts are standardized, being machined from jigs permitting interchangeability of all parts, all of which are certain to fit.



The friction case is a square, open box, provided with supporting lugs or feet; a cover is provided for the easy inspection of working parts, and a circular opening on the motor side for removing the hub. This case contains the following essential parts: Square stationary friction plates, prevented from rotating by studs at four corners of case, and free to move laterally; circular moving plates supported by and keyed to the hub, and free to move laterally.

The hub is made of steel, with keys cut from the solid, supported by and keyed to the motor shaft. It is provided with an oil slinger to throw oil inside of the case and

prevent it running out at the hub opening. Lubricating oil is placed in the case to a depth of ½" below the lowest point of the hub opening. The moving plates dipping into the oil throw it by centrifugal force to the top of the case, from whence it drops onto the friction plates, effectually lubricating them. The oil also acts as an agent to carry the heat away from the friction plates.

The electro-magnet is mounted on the studs which prevent the stationary plates from revolving. The coil of this magnet is form wound, thoroughly insulated and treated with a vacuum and drying impregnating process which practically converts the copper and insulation into a solid mass, thus excluding all moisture from the coil and aids in the dissipation of the heat. This brake is designed in three forms to meet the service demanded in different classes of electrically driven machinery.

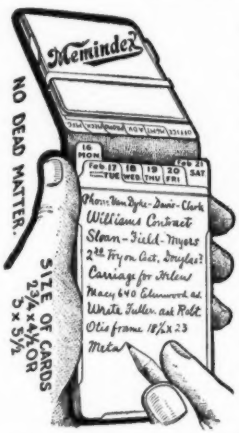
The Memindex.

THE "Memindex," partially illustrated herewith, consists of a leather vest-pocket card-case, an index card for each day of the year, a cabinet for the cards not carried in the pocket case, and extra cards for records and special memoranda. The card case is 2¾ x 4¾ inches in size (or 3 x 5½), made of seal grain, real seal or Russia leather, in a thoroughly workmanlike manner, and will stand hard usage. The light metal pocket which retains the diary cards is heavily nickeled and is permanently secured to the leather by an original device. It carries diary cards for two weeks, which are held from slipping by a blotter cushion at the back, on which is printed the yearly calendar. Extra blotters are provided, and may be attached so as to meet the writing when the case is shut, if the user prefers to use a pen.

The other pocket consists of a leather flap held with the contents under a retaining band, securely fastened under the lining; thus making an elastic pocket that will not allow its contents to slip. It is intended to hold six or twelve tab-cards for the classification of special memoranda, and a few record cards for the index system. A simple clasp holds the covers when closed, and releases without any extra motion.

The Memindex is used in this way:

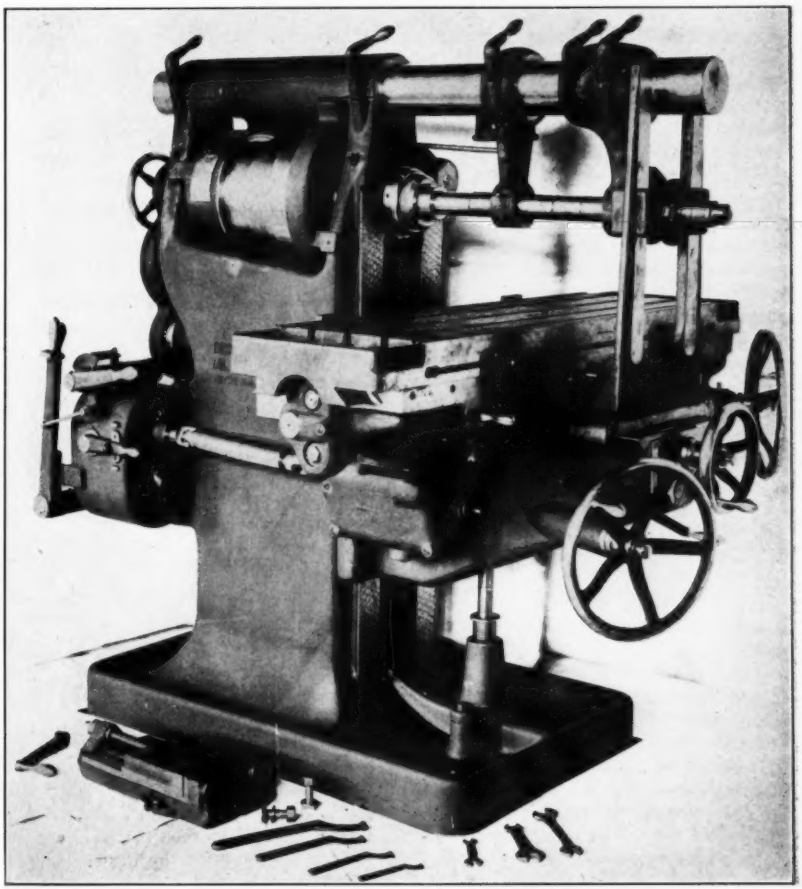
Diary cards for the present week and the week following are carried in the case, the card for the present day being at the front with its face exposed for writing or reference. Jot down on it the matters you might forget to attend to to-day—letters to write, appointments to meet, customers to see, telephone calls, matters to be looked up, details of business or personal matters that you wish to be reminded of as the day goes on. If anything is to be attended to to-morrow or any day for two weeks ahead, the card for that day is instantly produced by pulling up its tab. If it is more than two weeks ahead, jot it on one end of the (tables) record cards and drop it in the cabinet at the right place when you return to your desk. Thus it will come to the front at the right time, being copied on the card for that day unless (as frequently happens) the matter is disposed of or postponed before that day arrives. During the day you will frequently consult your memoranda for guidance. This is made very easy and convenient, as there are no leaves to turn—the case always opens to the right place and the day's card, being always at the front, is exposed to view. The jotting of all little matters liable to slip makes the reminder more constant, and thus the habit of frequent reference is easily formed, which usually helps a man to work his plan, having planned out his work to the best advantage. When away from his desk he carries the case in his pocket. When done with the day's card, file it back of the others till the end of the week, when the cards may be thrown away or filed in the back of the cabinet. The first cards at the front of the cabinet are always the next to go in the pocket case.



Manufactured by Howard L. Wilson, 27 Mill street, Rochester, N. Y.

New Milling Machine.

BECKER-BRAINERD MILLING MACHINE CO., Hyde Park, Mass., are showing their No. 4, plain milling machine, gear feed. This machine embodies a number of new and important improvements which will be much appreciated by all users of milling machines. Special attention is called to the positive gear-feed drive and change-feed mechanism, by which twenty changes of feed can be made without stopping the machine; the new clutch mechanism in connection with the hand wheels; also the box type of knee and telescopic elevating screw.



The spindle has a No. 12 B. & S. taper hole in front end, is made from hammered crucible steel, has a ¾-inch hole through its entire length, and runs in self-centering bronze boxes arranged to compensate for wear. It has a slot across end to engage clutch on arbor, is threaded to take a chuck, and a threaded collar covers the screw when not in use. It is connected with the change-feed mechanism by three spur gears, making a positive-driven feed. The spindle is double back geared, and gears are protected with guards.

The arm is made of steel, is designed for horizontal adjustment, and has an arbor support which may be removed, so that any of the attachments can be placed in position without the necessity of removing the arm.

The platen has automatic longitudinal,

cross and vertical feeds. It is provided with three ¾-inch T slots with oil pans at each end. Feed is reversed in front of machine.

The knee is of box type, and is supported by telescopic elevating screw, so that no holes are necessary in the floor. It is also provided with automatic vertical feed and knock-off.

Hand wheels for operating the feeds are provided with clutch arrangement enclosed in hub. When the table has been set to required position, the clutch may be instantly disengaged by pressing in the knob on the front of the hand wheels, thereby preventing any accidental change from their fixed position, and also preventing them from revolving when the automatic feeds are thrown in.

Dials are adjustable and graduated to read to thousandths of an inch, to indicate the vertical, transverse and longitudinal movements of platen, and are set at any position with set screw.

The patented change-feed mechanism is conveniently arranged on the back of column, and is capable of obtaining instantly twenty changes of speed, slow or fast, by a simple movement of the lever without stopping the machine.

An Interesting Gasoline Car.

IN sparsely settled districts, where the cost of operating a steam drawn train is excessive and the immediate investment of capital for an electric service unwarranted, there has arisen a need for a self-contained car which shall be independent of a feeder system, and at the same time be cheaper to operate than the ordinary locomotive and train. For this purpose, the General Electric Company, in conjunction with the American Locomotive Works, at Schenectady, N. Y., has recently completed a gasoline-electric car which presents many features of interest as a proposed solution for this go-between.

The first trial run of this novel car took place February 3d, when a successful trip was made from Schenectady to Saratoga, and return. During the trip several important features of this method of driving were demonstrated. While the car was not designed for high speed, the average running time was about thirty-five miles an hour, and several times the car attained a speed of over forty miles an hour. The smooth and rapid acceleration was most favorably commented upon by the engineers present, as well as the complete absence of vibration which might be thought to accompany the use of a gasoline engine. The car consists essentially of a gasoline-driven electric generator furnishing current to electric motors geared to the driving wheels and controlled by a method similar to that employed in the ordinary electric equipment. The car is of the combination type, comprising a passenger compartment, smoking room, a baggage room, engine room, one toilet and a motorman's compartment. The car is 65 feet long over buffers and equipped weighs 65 tons. A complete controlling equipment is located at each end of the car, one controller being located in the engine room, and a similar controller in a compartment at the other end. The car has seating capacity for forty passengers, including seats for twelve in the smoking room. In general, it is built on the lines of a standard passenger coach, and is handsomely finished.

The gasoline engine for this car was built by the Wolseley Tool and Motor Car Company, Ltd., of Birmingham, Eng., and is considered the most powerful unit yet constructed for this class of work; it develops 160 B. h. p. at a speed of 450 r. p. m. The cylinders are horizontal opposed, six in number, 9″ diameter, 10″ stroke. All valves are mechanically operated, and the cylinders are water-cooled. Hitherto, difficulty has been experienced in starting internal combustion engines of this size, but in the present case this has been entirely overcome by using shells filled with black powder to provide the initial charge in one cylinder. On starting the engine, the shell is fired by a hand trigger, the whole being similar to the breech mechanism of a gun. Jump spark and low tension ignition are both provided, current being furnished to the latter by a small magneto driven by the engine shaft.

The volatilization of the liquid fuel is produced in two carburetors which form an integral part of the engine. Each carburetor supplies three cylinders and is equipped with two float feed chambers. The chambers are identical and are of the usual needle valve type. Very flexible arrangements are provided to govern the air supply so that it may be taken from the atmosphere or from the

crank chamber, or from both according to the conditions required. The mixture is heated to the required temperature in a small chamber which itself is warmed by the exhaust. In all details the engine is very complete. The lubrication is especially so, being force feed for main bearings and pistons and drip feed for all other working parts. Gasoline is stored in steel tanks beneath the car, and the burnt gases pass through the roof into mufflers, from which they exhaust into the air. The cooling system for the cylinders consists of radiating tubes, located on the top of the car. Water for cooling is contained in the engine base. For heating the car, a three-way cock is provided which by-passes the circulating water through the usual pipe heating system within the car.

The transmission is electrical, consisting of a generator and standard railway motors. The current is furnished by a 120 kw. direct connected General Electric six pole generator designed for 600 volts. This generator is provided with commutating poles, which in connection with the method of voltage control, permits a very flexible operating system. The advantage of commutating poles is evident when it is considered that the field excitation at starting is weak, and a large current at low voltage is required to give the necessary starting torque. Owing to the peculiar operating conditions of this system, the generator, while retaining the characteristics of a shunt wound machine, is separately excited by a 5½ kw. two pole compound wound exciter working at 110 volts. This is located on top of the generator, and is driven by a Morse silent chain.

There are two General Electric—69 motors of standard railway construction, similar to those used on the Interborough, New York.

For regulating the speed of the motors, as mentioned above, voltage control is used; in other words, the speed of the car is governed by varying the field strength of the generator. With this method the speed of the engine remains constant after acceleration. The controller is semi-automatic, and can be set for any predetermined maximum acceleration. It is arranged for series parallel control, the motor connections being changed from series to parallel by the reversing handle. This latter has five positions, "series ahead," "parallel ahead," "off," "series reverse" and "parallel reverse." Arrangements are provided to prevent the motor connections from being changed from series to parallel until the resistance is put into the field circuit of the generator.

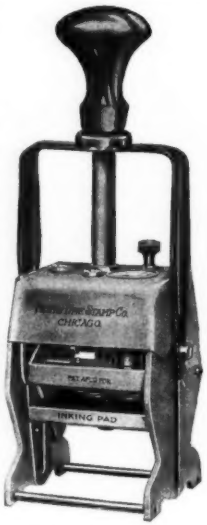
Further operating details comprise a General Electric combination straight and automatic air brake equipment, and a special lighting equipment. Meridian lamps are used, equipped with Holophane reflectors, the whole affording a very satisfactory system for car lighting. The headlights are supplied with 100 c. p. incandescent lamps of the stereopticon type, one for each end of the car.

The trial trip of this car demonstrated the practicability of this equipment, and was entirely satisfactory to the engineers and officials present so far as the tests indicated. The opinion was expressed that this was merely a step toward the final electrification of all service. A gasoline car would be useful in establishing a passenger traffic, but eventually the motive power for operation would be electricity.

The Perry Time Stamp.

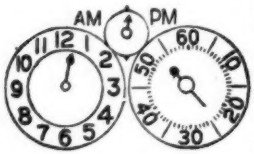
THE manufacturers of time stamps, it seems, have done considerable experimenting to produce a time stamping device which could be so arranged and constructed that the clock-work would be free from jar in using the stamp to make the time impression. The Perry Time Stamp Co., of Chicago, have recently brought out an improved model, a view of which we publish below. This stamp is constructed entirely of aluminum, hard brass, and steel, weighing but 30 ounces in all, but its construction is such that in all surfaces subject to wear hard brass is in contact with steel, and all of the bearings of the stamp are steel rollers. The element of friction therefore, is almost eliminated. This stamp is constructed with a clock dial on the top, so that the stamp serves the purpose of a desk clock as well as a time stamp. The clock work is enclosed in a dust proof aluminum case, and the clock-works are connected with a printing mechanism through the medium of a synchronizing staff and wheel, which are incased in a barrel, so that in its normal position the works are entirely

enclosed. When the handle is moved down to cause the impression of the printing dials the printing die train is automatically locked so that it is not possible to tamper with it or change the time, and when the handle is released, though it may have been held down for 14 minutes, it will adjust itself upon returning to its connection with the clock mechanism.



The clock-works are so balanced on equalizer springs that the jar occasioned by placing the stamp in position for stamping does not in any way reach them, and during the actual act of stamping the force of the blow is received by the desk supporting the object being stamped, the printing mechanism being entirely disconnected from the clock work at the time, and any vibration which would ordinarliy disarrange the clock-work is taken up by the yoke and spiral spring, the clock-work being entirely relieved of any jar or straining, and not interrupted in its regular action.

The inking device is normally out of contact with the printing dials. Upon pressure being put upon the handle of the stamp, the ink pad moves into contact with printing dial plate and inks it evenly, then drops to the back and out of the course of the printing dial plate. The ink pad is detachable. It can be easily removed to be reinked and returned to its place without effort.



The printing die plate has ample room in addition to the dials and date, for any inscription desired in the ordinary course of business, and this time stamp is especially adapted for timing employees in and out of factories. It not only takes the place of a large and expensive time recorder in this instance, but may also be used to great advantage in keeping record of the exact labor expended on each job passing through the factory, by means of records on job tickets or cost cards; and for use in the office for stamping time of receipt of letters, orders, telegrams, telephone messages, or other documents, as well as for noting the time of packing and shipping orders, and keeping a check on teamsters, it will be found invaluable. This is proven by the fact that some of the large railroads in the country have adopted this type of time stamp for noting the time of receipt of goods at their various freight receiving doors, and it has also been adopted by representative concerns in engineering lines, for various purposes. Full particulars will be cheerfully furnished by the Perry Time Stamp Co., 72 So. Canal street, Chicago, Ill.

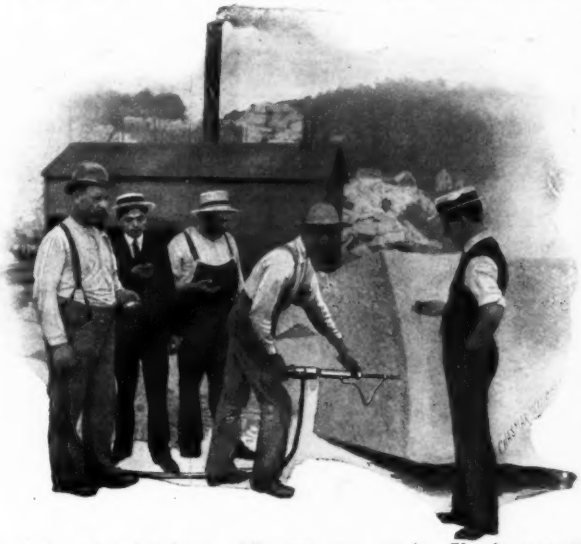
Sullivan Plug Drill.

THE accompanying illustration is from a photograph of a test of the new Sullivan plug drill, manufactured by the Sullivan Machinery Co., Chicago, Ill., and Claremont, N. H., on the Innes & Cruickshank quarry at Barre, Vt. This test exceeded by far all records for plug holes which had been made up to that time. The test lasted one hour, during which time the drill put in 160 plug holes, $\frac{5}{8}$" in diameter by 3" deep. The best previous record was 60 holes in one hour. One of the company's regular quarrymen handled the drill, which used 13 cu. ft. of free air per minute at 100 pounds pressure. Both vertical and horizontal holes were bored during the test.

A few days later, at the Boutwell quarry of the Boutwell-Milne-Varnum Co., which contains one of the hardest granites in the Barre district, one of these drills put in 200 plug holes of the same size as above described, in the same time, one hour.

The drill weighs 19 lbs. and uses 13 cu. ft. of free air per minute under 100 lbs. pressure. It uses a solid steel rotated by a hand wrench, and drills holes up to 12 inches in depth. A blower hose, attached to the exhaust opening on the cylinder, automatically cleans the hole of dust. The cylindrical throttle valve is placed in the drill head, and

is opened by pressure of the handle upon the head when drilling is begun. On releasing the handle, the throttle is closed by air pressure. It is impossible for this mechanism to get out of order, as there is no trigger to be worked by the fingers. The valves, valve block, drill shank bushings and cylinder are made of hardened tool steel and are



warranted against breakage. All parts are made perfectly interchangeable, so that in case of accident new parts may be put into the machine without delay or trouble.

Several months have been spent by the company in perfecting and systematizing methods of manufacture, and it is now confidently believed by them that the Sullivan plug drill is now superior in point of drilling speed and durability. The company offers to send drills out on 15 days' trial, and will pay all shipping expenses from and to the factory if the purchaser is not satisfied with its performance. Bulletin 51-C, just issued, describes the drill fully, and may be had on application to the Sullivan Machinery Co., Claremont, N. H., or Chicago, Ill., or to the nearest branch office.

Vertical Variable Speed Motors.

THERE is a large field of application in modern industrial plant work for the vertical motor. Its use enables the machine designer to do away with the necessity of turned belt, beveled gears, etc. The equipment makes the driven machine far more compact in arrangement and, of course, secures far greater economy of operation than is possible by ordinary means of power transmission.

The Northern Electrical Manufacturing Co., Madison, Wis., has paid special attention to the development of vertical motors and in its design eliminates all of the trouble due to lubrication of a vertical armature shaft. The Northern vertical motor is extensively employed in all fields of work. Where required the Northern single voltage system is applied to the vertical motor, thus making it possible to operate the driven machine at the speed best suited to the requirements of the work. Simple controlling devices are used for the Northern single voltage system and the motors operate from any ordinary two-wire single voltage direct current circuit.

Silent Streets.

THE noise and tumult permitted in New York streets has long been an unfailing source of astonishment to foreigners coming to this country for the first time. The uproar of our streets is in marked contrast to the comparative silence of the streets of London or Paris. New York has just begun to use the same device which has been employed in those cities to abolish this nuisance, namely, pavements of wood block instead of stone or asphalt on streets carrying heavy traffic. The comparative silence of such streets has been to Americans one of the greatest charms of the European capitals. Wood pavements were introduced in this country a few years ago by the U. S. Wood Preserving Company, who used pine blocks treated by the creo-resinate process.

This process impregnates the blocks with a mixture of creosote and rosin. The creosote acts as a preservative, taking the place of the sap in the wood, while the rosin hardens the block, making it waterproof, and keeps the creosote from washing out or evaporating. These blocks have been tested for several years on some of the downtown side streets of New York, and have met with such universal public approbation, that the "silent pavement," as the newspapers

call it, will be extended to cover practically the entire office building district. Broadway, itself, from the Battery to Vesey street, is soon to be laid with this pavement, in response to petitions from property owners. It is probable that these blocks on Broadway will last without repairs for some twenty years. On Tremont street, Boston, careful measurements indicate a wear of less than one inch in sixteen years. New York, if it continues the adoption of this pavement, is destined to become the best paved city in America.

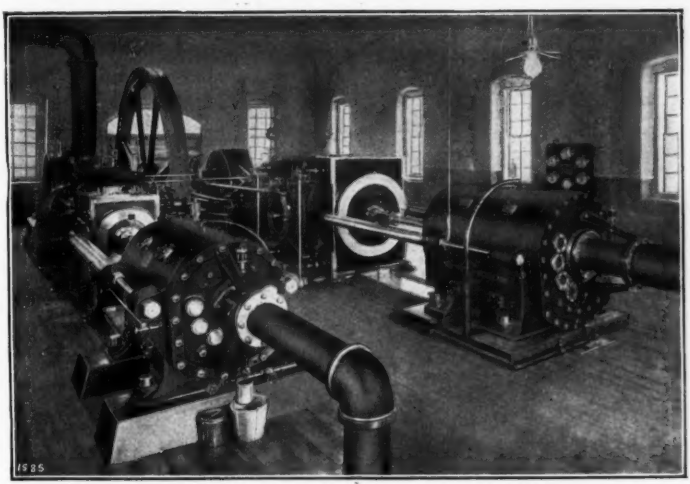
Air Compressors at the Champion Copper Mine.

THE mining of copper is probably the most expensive form of mineral production, and of all copper mines, those of the "copper country" of Lake Superior have the highest operating cost. Low grade values, extended deposits, and immense depths make mining costs high and necessitate the most economical methods of operation. Among the twenty-two producing mines of the Lake Superior district, the "Champion" ranked fifth in production in 1904, being credited during that year with an output of 12,500,000 pounds of refined copper. The mine is at Painesdale, Mich., and is one of several large properties owned and operated by the Copper Range Consolidated Copper Company. Under present average conditions of operation its output is about 2,000 tons of ore per day, which is hoisted through four shafts well scattered over the extensive property.

One of the largest compressors in the district is located on this property and was built by the Ingersoll-Sergeant Company, of New York. It is a duplex Corliss type with cross-compound condensing steam cylinders and two-stage air cylinders. Steam is supplied at 130 pounds by a battery of high-pressure boilers in an adjacent boiler house. The steam pipe enters the

basement of the compressor house and rises through the engine room floor to the high pressure steam cylinder. The exhaust passes to a Worthington condenser located, with its pumps, in the basement below. A vacuum of about 20 inches is maintained. The steam valve gear is of standard Corliss release type. Automatic regulation is secured by an improved governor in which the usual fly-balls are supplemented by a governor cylinder through which receiver air pressure operates to vary the cut-off on both cylinders, adjusting the speed to the demand for air and maintaining air pressure constantly. The main frames are of standard heavy-duty tangye pattern, and cranks are of balanced disk type. High and low pressure air cylinders are completely water jacketed on heads and barrels. Cold air is drawn from outside the building through a duct terminating in an intake bracket supported on the compressor foundation. The Sergeant piston inlet valve handles the intake on both high and low pressure cylinders. Direct-lift discharge valves are used. A vertical receiver intercooler stands between the cylinders 48 inches in diameter and 13½ feet high, with tinned brass tubes through which the cooling water circulates. Steam cylinders are 18 and 36 inches in diameter; air cylinders, 20¼ and 32¼ inches. The stroke is 48 inches. The normal speed is 72 revolutions per minute, at which the free air capacity of the compressor is 3,100 cubic feet per minute. The air pressure is 80 pounds.

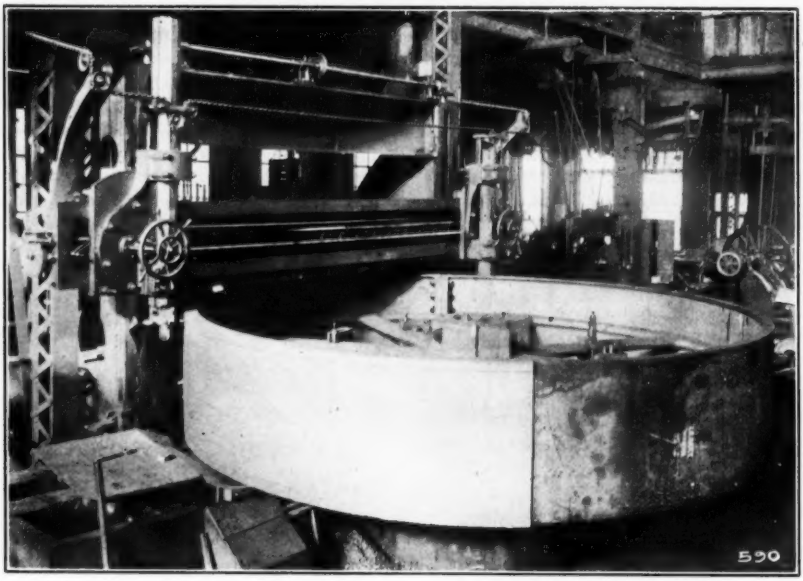
The compressor building is an iron covered, steel-framed structure lined with sheathing and floored with matched wood. A solid concrete foundation, capped with finished stone, supports the compressor. The illustration shows the interior of the engine-room with the intercooler in the right foreground. The stairway on the right leads to the basement, which contains all auxiliaries, beside an engine-driven generator for lighting purposes.



A Novel Job.

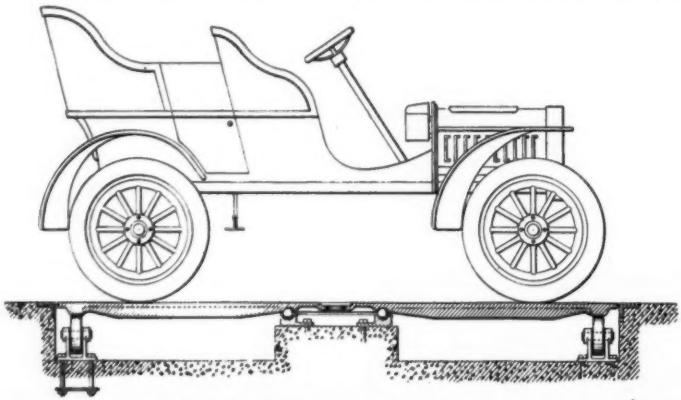
H. W. CALDWELL & SON COMPANY, Chicago, have lately cast in their foundry and finished in their shops a single half of the large split band wheel shown by the accompanying photographs. An entire band wheel was originally made by another foundry, but in putting the wheel in place on the crank shaft of the engine, one of the halves was accidentally dropped into the pit and broken. It was a planed-joint wheel, and such wheels are, of course, always cast in separate halves or sections; but it is unusual for one foundry to cast a half to match another half made by some other foundry of whose cupola mixture or practice nothing is known. Inasmuch, however, as the order for a new half was given, the

Caldwell engineers analyzed the metal in the old half, figured out a mixture to give the same shrinkage, molded the new half in loam, cored out the hub and arms in the ordinary way and poured. After the preliminary work of cleaning, chipping, drilling, facing, etc., had been done, the new and the old halves were bolted together and put on a 20-foot boring mill. Part of a cut having been taken around the face, a photograph was made. The darker half, with the chalk markings on it, is the old half; the other, the new one. The face was then finished and the wheel arranged for the boring of the hub. The diameter of the wheel is 18 feet, the face 42 inches, the bore 15 inches, and the weight 27,806 lbs.

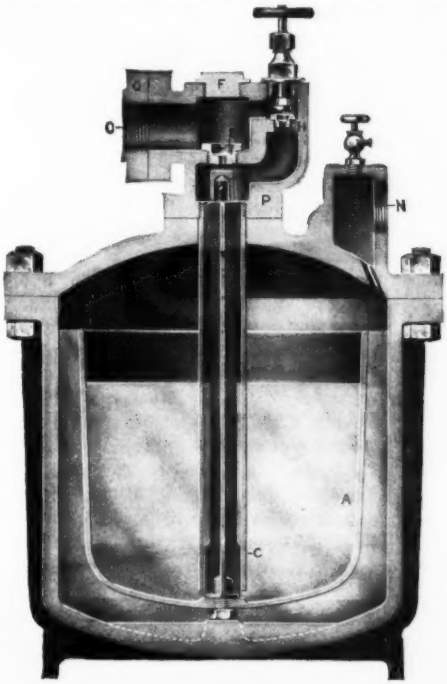


Automobile Turntable.

THOSE who have to do with automobiles in garages and factories will be interested in a turntable that facilitates the handling of the cars and overcomes the unsatisfactory maneuvering by hand. The device shown by the illustration is manufactured by the Link-Belt Engineering Company, of Philadelphia, and is es-



sentially designed for easy operation. It consists of a cast-iron table fitted at its center with ball bearings and supported at the outer edge upon rollers. The latter are set in a concrete pit having a center pier upon which the ball-race is securely fastened. The wall of the pit is protected by an iron ring, or curb, which effectually prevents mutilation of the concrete edge. The shallow depth of the drained pit makes the expense of excavating and cementing small, while the diameter of the turntable is ample for a wheel base of 96 inches. Level surface connection is maintained with the surrounding floor when the turntable revolves, or is at rest. A brake is furnished and is depressed or let into the floor and top of turntable, ensuring freedom from obstruction and providing a rigid fastening when the turntable is not in use. Hand-holes with flush-top lids are also provided. The construction of the turntable and its recess is a protection against fire that may result from dropped oil or waste becoming ignited, an element of danger where wooden tables are used.



The Albany Steam Trap.

THE Albany steam trap is made for very high working steam pressures and where a high degree of superheating is employed. Under these conditions, with the great velocity of the escaping water and the high temperature, the best steam metal used in the ordinary construction of the valve and its seat will only remain tight for a short time, when they have to be removed.

To overcome in part this deficiency and make a practical working trap, the valve and its seat are made of a special hard bronze metal to resist as much as possible the wear due to the velocity of the escaping water. The construction is arranged in such a manner that when it becomes necessary to remove the valve and its seat, it can be done in a few minutes without taking the trap apart, the renewals being very cheap and simple. The copper air float, so very unreliable under the higher working pressure, is not employed, the cast iron bucket that will last as long as the outer case being used.

The cut here shown is a vertical section through the trap, showing very clearly the inner construction: A is the bucket; B is the bucket valve-stem; C is the guiding pipe that screws in the lower side of the valve-body P, and M is the outer case; O is the discharge opening; G is the flange that the discharge pipe screws into; F is a threaded cap; E is the valve-seat; D is the valve; H is the by-pass valve-seat; J is the wrench for screwing the valve E in its place; K is the wrench for screw-

ing the by-pass valve-seat H in its place; S is the by-pass valve-stem.

The operation of the trap is as follows: The water and steam when connected to a system of piping enters through the opening N, the water separating from the steam, and first falls into the space between the outer case and the bucket; the water will cause the bucket to be floated upward until the valve D reaches the valve-seat E, preventing the escape of either water or steam, the water continuing to flow in from the system it will finally fill the space between the case and the bucket; it will then overflow the top of the bucket and begin to fill it, and as the bucket is of cast iron and of considerable weight, when it has received a certain amount of water, the weight of the water, along with the weight of the bucket, will be enough to overcome the buoyancy of water contained in the space between the case and the bucket, it will drop to its lowest position the same as is shown in the cut. In this position the valve D is removed from its seat and the pressure of the steam contained in the upper part of the case will force the water from the inside of the bucket up through the pipe C, valve E and opening O to the atmosphere, and when enough water has been forced out of the bucket to lighten it below the buoyant power of the water contained in the space between the case and the bucket, it will rise and close the valve-opening, preventing the further escape of water until such time as there has been enough received from the system to again sink the bucket as has before been explained.

To replace the valve D remove the nuts from the standing-bolts and disconnect the flange G; then lift the valve-body P having the guiding pipe screwed in it clear of the trap bonnet; the bucket valve-stem will be seen to project above the top of the trap; then remove the split cotter-pin that secures the valve to the stem; you can then remove the valve D and replace it with another one if so desired. We will say after replacing the valve, and you have replaced the cotter-pin, be sure to spread the split ends of the cotter-pin so that it will not drop out of place. You can then replace the valve-body in its regular place.

To remove the valve-seat E remove the screw cap F and use the wrench J to unscrew the seat. To remove the by-pass seat H use the small wrench K. These wrenches are furnished with the trap. To renew the valve on the by-pass stem S unscrew the cap from the body the same as the ordinary globe valve.

Full details will be furnished by the Albany Steam Trap Co., Albany, N. Y.

—The Abner Doble Co., of San Francisco, has recently received several orders for Doble tangential water wheels. Among them is an order from the California Gas & Electric Co. for a 9,000-horse-power wheel for its de Sable power plant. The wheel will operate under a head of 1,530 feet at 400 revolutions per minute and will be driven by a single jet of water, thus making it the most powerful water wheel ever constructed for operation under a single jet of water. Another order from the California Gas & Electric Co. calls for six 570-horse-power wheels for its Nevada City plant. These will operate under a 190-foot head at 410 revolutions per minute. A 400-horse-power Doble wheel for operation under a 400-foot head, equipped with jet deflector operated by a Woodward compensating governor, has been shipped to the Chancellor Gold Mining Co., Wenatchee, Wash. The La Grande Water Storage Co., La Grande, Ore., has purchased an 800-horse-power, 1,150-foot head, 600 revolutions per minute Doble wheel, equipped with Doble needle regulating nozzle for operation by a Lombard governor. Among other recent orders secured are two double 1,750-horse-power wheels for the San Joaquin Power Co., Fresno, Cal., for operation under 385-ft. head; one Doble needle regulating nozzle for a large water wheel for the Komata Reefs Gold Mining Co., New Zealand, and a double 700-horse-power water wheel unit for Mitsui & Co., Japan, for operation under 210-foot head, this order including the wheel complete with Lombard governor and gate valve. The University of Michigan has purchased the Doble tangential water wheel which the Abner Doble Co. exhibited at the St. Louis World's Fair and for which the company was awarded the Grand Prize.

NEWS SUPPLEMENT

Personal.

—Sheldon E. Bent will be connected with the Railway Appliances Co., Chicago, in their track department.

—James L. Bernard has resigned as sales manager of the Northampton Portland Cement Co., to assume a similar position with the Alma Cement Co., Wellston, Ohio.

—William T. Dean, for the past four years chief electrician for the Illinois Steel Co., South Chicago, has resigned to enter the service of the General Electric Co.

—James A. Milne, who has for a number of years been comptroller of the Allis-Chalmers Co., Milwaukee, has accepted the position of general manager of Allis-Chalmers-Bullock, Ltd., Montreal.

Industrial Notes.

—The Robins Conveying Belt Co., New York, has recently opened an office in the Frick Building, Pittsburg.

—Miller-Collins Co. announce that they have moved to their new and spacious offices at 29 Broadway, New York.

—The American Steel Dredge Works, Logansport, Ind., now have their complete plant in operation.

—The National-Acme Co., Cleveland, announce that they have opened a Chicago office and warehouse in the Edgecomb Building.

—Railway Appliances Co., Chicago, announces that it has taken the sales agency for the elastic nut manufactured by the National Elastic Nut Co., Milwaukee.

—A new building is to be erected immediately at the Worcester Polytechnic Institute, to be devoted to the department of electrical engineering.

—M. K. Barnum, assistant to the second vice-president of the Chicago, Burlington & Quincy Railway, addressed the engineering students of Purdue University recently on the subject of "Engine Failures."

—The Burroughs Adding Machine Co., Detroit, are sending out to the users of their machines, a souvenir in the shape of a reproduction from the original painting entitled "Morning," by Carle J. Blenner.

—American Skylight & Iron Works, Jersey City, has secured the contract for placing forty skylights on the new shops of the Payne & Joubert Machine & Foundry Co., Birmingham, Ala.

—The Abner Doble Co., San Francisco, announces that it has opened a branch office in Los Angeles at 447 Pacific Electric Building. L. Cummins will have charge of the office.

On March 1st, Dodge & Day will remove to their new offices, located in the Drexel Building, Philadelphia, in order to obtain more commodious quarters. This step is the natural result of the rapid growth of their business.

—De La Vergne Machine Co., New York, have been awarded one of the largest orders ever placed for oil engines by Burnham, Williams & Co., Philadelphia. The order is for engines aggregating over 3,300 actual horse power.

—The American Car & Foundry Co. have purchased for their works at Manchester, England, 100 tools, consisting of Boyer hammers and drills, from the Consolidated Pneumatic Tool Company, London, which is a foreign branch of the Chicago Pneumatic Tool Co., Chicago.

—The Sullivan Machinery Co., Chicago, reports the appointment of H. T. Walsh, as manager for the Pacific Coast, with headquarters with Henshaw, Bulkley & Co., San Francisco. Mr. Walsh has represented the Sullivan Co. in the Rocky Mountain region for a number of years. Henshaw, Bulkley & Co. will continue to carry a stock of Sullivan rock drills and compressors.

—The Lawrence Pump & Engine Co., Lawrence, Mass., have just installed one of their multiple stage centrifugal pumps at the works of Joseph Benn & Sons, Providence. This pump is required to deliver 1,000,000 gallons of water per day against a head of 184 feet. They have also been awarded the contract for the centrifugal pumps to be installed at the Arlington Mills, Lawrence.

—A practical demonstration of the Hercules cement stone machine, manufactured by the Century Cement Machine Co., Rochester, was given at the Cement Users' Convention held in Milwaukee in January. Blocks, cornices, lintels, etc., were made in very short time. The Hercules can make two stones of the same size and design, or of different size and design, at one time.

—G. & H. Barnett Co., Philadelphia. some months ago purchased considerable ground adjoining their works, enabling them to erect a number of buildings in which to accommodate more machinery, and to build large additions to present buildings in order to give them increased capacity. These improvements and enlargements have now been completed, resulting in a vastly larger daily production.

—Announcement is made of the formation of the Electric Cable Co., Bridgeport, Conn., which succeeds the Magnet Wire Co., and the Peerless Electric Co., both of New York. The company is erecting a large factory in Bridgeport, where it will manufacture magnet wire, field and armature coils, and valtax, the new non-rubber insulation. The New York office will be at 42 Broadway.

—The second award of the John Fritz Medal has been made to George Westinghouse. This medal was established by the professional associates and friends of John Fritz, of Bethlehem, Pa., on August 21, 1902, his eightieth birthday, to perpetuate the memory of his achievements in industrial progress. The medal is of gold, of value of about $100, and with it is presented a certificate of the award. It was awarded to George Westinghouse for "The Invention and Development of the Air Brake."

—The Abner Doble Co., San Francisco, has recently taken a contract for a Doble tangential water wheel unit which will have a capacity of 13,000 horse power, thus surpassing in power any tangential wheel now built or contracted for. The unit has been ordered by the California Gas & Electric Corporation, for installation in its noted Colgate plant. They have also ordered from the Doble Co. a Bethlehem nickel-steel hollow forged shaft, with two 16-inch Doble ring-oiling and revolvable-shell bearings, for its Centerville plant.

—An unusually attractive little mailing card combining the artistic and the practical has just been published by the De La Vergne Machine Co., New York. The card contains a three page table of properties of saturated ammonia gas by Prof. DeV. Wood, extended by G. Davidson. The first page bears a half-tone cut of one of the Company's standard horizontal refrigerating machines and a line cut of a series of bars the length of which represent the gross tonnage of refrigerating and ice-making machines of the 43 largest builders.

—During the twenty-five years the Hohmann & Maurer Manufacturing Co., Rochester, have been making thermometers for all industrial purposes, they have several times been obliged to move to larger quarters to accommodate the increasing demand. To provide for future growth, they have purchased a tract of four acres, on which they have erected a manufacturing plant having 65,000 feet of floor space, with room for three times present space. This building not only trebles their capacity, but gives them many other advantages such as naturally follow manufacturing carried on under modern factory equipment.

—The use of the electrolytic process for the treating of ores is constantly increasing. An indication of this is shown by an order just placed with the Crocker-Wheeler Co., Ampere, N. J., through its New York branch. The order calls for two size 898 Crocker-Wheeler engine type direct current generators, with a capacity of 10,000 amperes and 105 volts. These will be special machines with 22 poles. The speed will be 100 revolutions per minute. They will be installed at Carteret, N. J., in a plant where there are at present four Crocker-Wheeler generators of varying capacity up to 750 kilowatts.

—A chair in electric railway engineering has been established at the Worcester Polytechnic Institute, and definite instruction in that branch of engineering is to be given during the coming year. Albert Sutton Richey, chief engineer of the Indiana Union Traction Company, has been appointed assistant professor of electrical railway engineering. Mr. Richey is a graduate in electrical engineering, Purdue University. The establishment of this chair of electric railway engineering is an im-

portant step in the development of the electrical department at the Worcester Polytechnic Institute, as this field of engineering bids fair to be of first importance in electrical work of the future.

—The surprising thing about variable speed motor drive is the facility with which the machine hand can alter the operating speed of his equipment, whether it be ⅛ horse power drive or 100 horse power drive. The manipulation of the motor controller lever enables the machine hand to adjust the operating speed of his equipment instantly and without effort. Northern variable speed motors are designed to respond to the motor controller with minimum effort of the machine hand, and to secure promptly the graduation of motor speed suited to the work or his own dexterity. Booklet No. 39, showing some motor drives embodying Northern motors, will be sent by the Northern Electrical Manufacturing Co., Madison, Wis.

—The Robins Conveying Belt Co., New York, has recently secured the following orders: Solvay Process Co., Syracuse, one 16-inch and a 24-inch belt conveyor; Highland Coal Co., Somerville, a bucket elevator; Western Engineering & Construction Co., San Francisco, a 30-inch conveyor; Imperial Japanese Navy, a 12-inch conveyor for their arsenal at Tokio; Bon Ami Co., Manchester, Conn., a bucket elevator; Pennsylvania Sand & Glass Co., Granville, Pa., a system of 14-inch conveyors and bucket elevators; Scofield Co., Philadelphia, a 30-inch and 18-inch conveyor; Depue Plant of the New Jersey Zinc Co., three belt conveyors; F. G. Boas, Philadelphia, a 14-inch belt conveyor; and Fraser & Chalmers, of South Africa, for a picking belt conveyor.

—The Chester B. Albree Iron Works, established in Allegheny, Pa., in 1885, has been recently incorporated under a Pennsylvania charter. Additional capital and the erection of a large addition to the works on adjoining land, together with new equipment of the latest design high precision tools, will enable the new company, which will be called the Chester B. Albree Iron Works Co., to continue the old lines of work to greater advantage and to take up the manufacture of the Inertia valve pneumatic tools, invented by Chester B. Albree, which the old company has spent three years in perfecting. The chipping and riveting hammers will be put on the market as soon as the additions to the plant will admit. The new company not only starts with the old members of the firm, Chester B. Albree and Ralph Albree, but has as its vice-president Sumner B. Ely, who was formerly chief mechanical engineer of the American Sheet & Tin Plate Co Among the directors and stockholders are Reuben Miller, of the Crucible Steel Company; C. F. Holdship, president of the Equitable Meter Co., and Frederick G. Ely, of the Pressed Steel Car Co., as well as other well known business men and capitalists. The capital stock, fully paid up, is $200,000, and the offices and works will be at 1116 to 1202 Market street, Allegheny.

NEW CATALOGUES AND TRADE PUBLICATIONS

These catalogues may be had free of charge on application to the firms issuing them. Please mention The Engineering Magazine when you write.

Arc Lighting Apparatus.

General Electric Co., Schenectady, N. Y.—Bulletin No. 4428, illustrating and describing arc lighting apparatus for use in shops, department stores, etc.; Bulletin No. 4429 treats of General Electric switchboard instruments, and Bulletin No. 4430 of variable speed motors as applied to machine tools.

Ball Bearings.

Hyatt Roller Bearing Co., Harrison, N. J.—Bulletin No. 28, containing a brief mechanical statement of facts explaining the advantages of the Hyatt roller bearing as well as a short treatment on its principal applications. Also contains a list of four hundred prominent users. Illustrated. 6¾ by 8½ in.; pp. 48.

Calculating Machines.

Calculus Co., Cleveland.—Pamphlet describing the advantages to be gained by the use of the Calculus. This machine adds, divides and multiplies.

Cement Stone Machine.

CENTURY CEMENT MACHINE CO., Rochester.—Handsome catalogue, explaining all about the 1906 model machine and illustrating factories, churches, residences and apartment houses built by Hercules machine made stone. 7½ by 10 in.; pp. 70.

Conveying Machinery.

C. W. HUNT CO., West New Brighton, N. Y.—Pamphlet No. 061, being an introduction to the general line of machinery manufactured by this company. Illustrated. 3½ by 6 in.; pp. 24.

Electric Fans.

DIEHL MANUFACTURING CO., Elizabethport, N. J.—Catalogue No. 17, very finely printed and illustrated, describing the Diehl electric fans for all currents except alternating. Ceiling, electrolier, column, eltctrolier column, universal desk, telephone booth and counter column fans are treated. 6 by 9 in.; pp. 32.

Feed-Water Heaters.

ALBERGER CONDENSER CO., New York.—Catalogue No. 6 is especially devoted to the Wainwright evenflow feed-water heaters and expansion joints, but it also contains illustrations of barometric and surface condensers, cooling towers, vacuum pumps, and pumping engines. 6 by 9 in.; pp. 36.

Electrical Supplies.

W. R. OSTRANDER & CO., New York.—The fourteenth edition of their catalogue illustrating and describing electric bells and batteries, electric burglar alarms, watchman's clocks, fan and power motors, arc and incandescent lamps, miniature lamps, electric heating specialties, etc., together with price lists. 6 by 9 in.; pp. 574.

Gauges.

AMERICAN STEAM GAUGE & VALVE MANUFACTURING CO., Boston.—Circular containing a brief description, with illustrations, of the American combined pressure and recording gauge.

General Machinery.

WILLIAMS, WHITE & CO., Moline, Ill.—Catalogue No. 7, illustrating and describing forging, punching, shearing and hydraulic machinery, heating furnaces, etc. Contains tables giving capacities of machines. Is well printed and finely illustrated. 7 by 9 in.; pp. 172.

Hydraulic Jacks.

WATSON-STILLMAN CO., New York.—Catalogue No. 68, being an assortment of sheets selected from over 600 pages of their printed matter, especially relating to hydraulic jacks. Is fully illustrated and contains tables giving size, weight and price of each jack. 6 by 9 in.; pp. 91.

Incandescent Lamps.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO., Pittsburg.—Booklet treating of the Sawyer-Man incandescent lamps. Standard, mill type, round bulb, tubular, lumino, reflector, railway street series, miniature, frosted, and colored lamps are illustrated and described. 5 by 8 in.; pp. 38.

Industrial Railways.

ARTHUR KOPPEL CO., New York.—Catalogue No. 111, treating of rails, steel ties, switches, turntables, and steel and wooden cars. Is well illustrated and contains many tables giving much valuable data. 8 by 10 in.; pp. 48.

Lathes.

UNITED ENGINEERING & FOUNDRY CO., Pittsburg.—Catalogue containing a brief illustrated description of their roll turning lathes, together with a list of some users of the same. 10 by 8½ in.; pp. 12.

Mining Machinery.

JEFFREY MANUFACTURING CO., Columbus.—Bulletin No. 11, well printed and finely illustrated, treating of "The Application of Electricity to Mining," by F. L. Sessions. 8 by 10 in.; pp. 46.

Mine Ventilators.

SULLIVAN MACHINERY CO., Chicago.—Catalogue illustrating and describing the Champion mine ventilator for ventilating mines, tunnels, buildings, etc. 6 by 9 in.; pp. 16. Also Bulletins Nos. 48 B and 48 E, dealing with the Sullivan mining machine for undercutting coal in room and pillar mines and the Sullivan automatic cross-over dump for the handling of coal, ore and rock from mines and quarries, respectively.

Perforated Metals.

THE HENDRICK MANUFACTURING CO., Carbondale, Pa., have issued their initial catalogue on perforated metals, and it is a most creditable and comprehensive work. There are sixty pages of text interspersed with numerous illustrations of standard and special screen plates, spark arrester plates, revolving screen, sections, etc., as well as various styles of elevator buckets, conveyor lining, troughs and flights, manufactured by them. There is, in addition, most valuable data in the way of engineering tables which will make the book a valuable one for reference purposes. 6 by 9 in.

Reinforced Concrete.

TURNER CONSTRUCTION CO., New York.—Catalogue containing illustrations showing a number of buildings both in course of construction and finished, with a brief description of each. Also contains a report of a fire, load and water test. 6 by 9 in.; pp. 68.

Rock and Ore Breakers.

ALLIS-CHALMERS CO., Milwaukee.—Instruction book No. 5000, containing instructions for setting and operating style "D" Gates rock and ore breakers; Bulletin No. 203 treats of Allis roller mills; Bulletin No. 1409 deals with McDougall roasting furnaces; Bulletin No. 1502 contains the reports of a test of the New York Subway engines; and Bulletin No. 1704 illustrates and describes lath mills and bolters. All of the above bulletins are finely printed and well illustrated.

Sheet Steel.

BROWN HOISTING MACHINERY CO., Cleveland.—Catalogue treating of the many uses to which ferroinclave may be adapted, and especially the merits of ferroinclave reinforced concrete roofs for steel frame factory buildings. Contains many fine illustrations. 6 by 9 in.; pp. 32.

J

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JOHN F. WALLACE ON THE PANAMA CANAL

INTRODUCTION TO AUTHORS, - PAGE 7
INDEX TO ADVERTISEMENTS, - " 11
THE BUYERS' DIRECTORY, - - " 18

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THE SQUARE DEAL IN WORKS MANAGEMENT—
III. What can be Done with the Workers — **O. M. Becker** 823
PLASTER MINING AND PREPARATION IN THE VICINITY OF PARIS—
An Industry Offering Many Opportunities for Modern Machinery — **Jacques Boyer** 850
THE ELIZABETH EYE-BAR SUSPENSION BRIDGE AT BUDAPEST—
Shop and Field Construction Methods of an Interesting Design — **Leon Ramakers** 860
A QUARTER-CENTURY OF ELECTRIC RAILWAY ENGINERING—
Important Steps Leading up to Heavy Alternating-Current Service — **F. Koester** 871
THE CHANGES OF ONE LIFETIME IN THE MACHINE SHOP—
A Record of Steady Advance in Materials, Methods, and Tools — **Egbert P. Watson** 883

REVIEW OF THE ENGINEERING PRESS.

THE NOTABLE ARTICLES OF THE MONTH—BRITISH, CONTINENTAL, AMERICAN—893-915
FOR FULL TABLE OF CONTENTS SEE PAGE 5.

THE ENGINEERING INDEX.

With Descriptive Notes Indicating the Exact Character and Purpose of Current Leading Articles in the Technical Press of Great Britain, the Continent, and the United States.

CIVIL ENGINEERING - - - - - - - 917
ELECTRICAL ENGINEERING - - - - - 924
INDUSTRIAL ECONOMY - - - - - - - 929
MARINE AND NAVAL ENGINEERING - - - 931
MECHANICAL ENGINEERING - - - - - 933
MINING AND METALLURGY - - - - - - 942
RAILWAY ENGINEERING - - - - - - - 950
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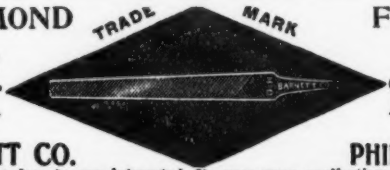

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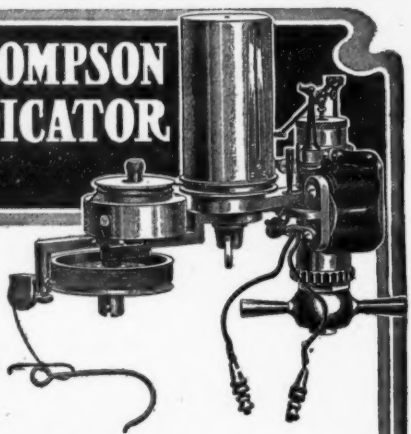

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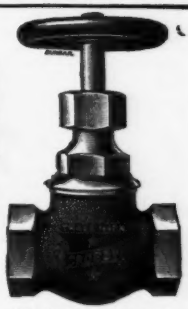

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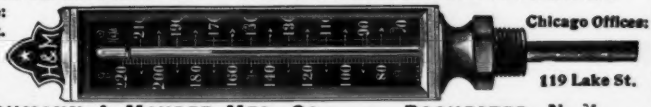

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CONTENTS, MARCH, 1906

Vol. XXX, No. 6

PLAIN FACTS ABOUT THE PANAMA CANAL—
What Red-Tape Costs, and What Contract Work will Save — J. F. WALLACE — 801

THE AMERICAN, AND THE GERMAN, "PERIL"—
III. American Trade Methods Tested by German Experience — LOUIS J. MAGEE — 816

THE SQUARE DEAL IN WORKS MANAGEMENT—
III. What can be Done with the Workers — O. M. BECKER — 823

PLASTER MINING AND PREPARATION IN THE VICINITY OF PARIS—
An Industry Offering Many Opportunities for Modern Machinery — J. BOYER — 850

THE ELIZABETH EYE-BAR SUSPENSION BRIDGE AT BUDAPEST—
Shop and Field Construction Methods of an Interesting Design — L. RAMAKERS — 860

A QUARTER-CENTURY OF ELECTRIC RAILWAY ENGINEERING—
Important Steps Leading up to Heavy Alternating-Current Service — F. KOESTER — 871

THE CHANGES OF ONE LIFETIME IN THE MACHINE SHOP—
A Record of Steady Advance in Materials, Methods, and Tools — E. P. WATSON — 883

REVIEW OF THE ENGINEERING PRESS

Fire Tests on the Experimental Theatre Building at Vienna—893
The Smoke-Abatement Conference in London—895
Shop Betterment and the Individual-Effort Method of Profit-Sharing—898
Commercial Applications of the Oxy-hydrogen Blowpipe for Welding—900
Types of Prime-Movers for Electric-Generating Station Service 902
Methods of Determining the Cost Elements for Preliminary Estimates—905
Automobile Vehicles for the Omnibus Service in Paris—907
Refractory Materials as Applied to Foundry Operations—909
By-Product Coke Ovens in the Coal Fields of the United States—911
Impact Testing for the Determination of Brittleness—913
The Relation of the Professor to Private Engineering Practice—915

THE ENGINEERING INDEX

With Descriptive Notes Clearly Indicating the Character and Purpose of Current Leading Articles in the Technical Press of the World

CIVIL ENGINEERING 917
ELECTRICAL ENGINEERING . . 924
INDUSTRIAL ECONOMY . . . 929
MARINE AND NAVAL ENGINEERING . 931
MECHANICAL ENGINEERING . . 933
MINING AND METALLURGY . . . 942
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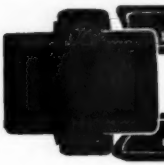

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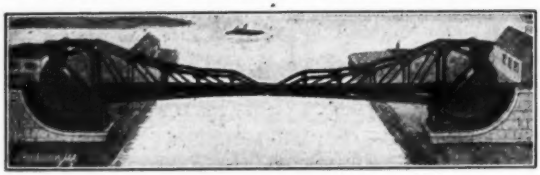

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JOHN F. WALLACE, D. Sc. LL. D. *(Plain Facts about the Panama Canal)*—Born in Fall River, Mass., September 10, 1852; educated at Monmouth College; entered railway service in 1869 as rodman; assistant engineer Rockford, Rock Island & St. Louis Railroad, 1870; assistant engineer U. S. Engineers, 1871; chief engineer and superintendent of the Peoria & Farmington R. R., 1879; master of transportation, Central Iowa R. R., 1883; bridge engineer of the Atchison, Topeka & Santa Fe, 1887; chief of construction of Sibley Bridge over the Missouri River, 1887; resident engineer, Chicago, Madison & Northern R. R., 1889; engineer of construction, Illinois Central R. R., 1891; chief engineer, I. C. R. R., 1892-1897; assistant second vice-president, I. C. R. R., 1898; assistant general manager, I. C. R. R., 1901; general manager, I. C. R. R., 1902; chief engineer Isthmian Canal Commission, 1904; member Isthmian Canal Commission, 1905; past president American Society of Civil Engineers; past president Western Society of Civil Engineers; past president American Railway Engineering and Maintenance-of-Way Association; member of the Institution of Civil Engineers of Great Britain.

LOUIS J. MAGEE *(The American, and the German, "Peril")*—Born in Malden, Mass., in 1862; was graduated (A. B.) from Wesleyan University in 1885; entered the shops of the Thomson-Houston Electric Co. at Lynn, and, after practical work there, erected several plants in the United States, and then spent a year and a half in Lima, Peru, for the same concern; in 1889 he took over the Thomson-Houston Company's office in Hamburg; this led to the formation in 1892 of the Union Elektricitäts Gesellschaft in Berlin, manufacturing on the basis of the experience of the General Electric Co. This company was a pioneer in electric street railroads in Europe. As one of the managing directors, Mr. Magee is identified with the German industry, and his review of the industrial and economic ideals of the two countries, written at the request of the Magazine, and represented by the third installment in this number, is inspired by an intimate knowledge of commercial and social conditions in the German Empire as well as the United States, and is animated by a desire for a better understanding between the industrial nations.

O. M. BECKER *(The Square Deal in Works Management)*—Born on a farm, some thirty-six years ago; elementary education received in district and village schools; graduated from college after reaching manhood, in 1897; supported family of four while in school, and finished course in much less than usual time; always inclined toward science and mechanics; teacher in district schools and principal in villages; after graduation, assistant in science laboratories, Kansas State Normal School; later city superintendent of schools in small cities, and conductor of teachers' institutes; came to Chicago in 1901 to study industrial-social conditions at first hand; soon afterward entered the employ of the International Harvester Company, where investigations were undertaken looking toward securing greater productive efficiency and bettering working conditions; became interested in the development of the new tool steels; more recently Supt. of McCormick Technical School, an attempt to solve the problem of factory education; in consulting practice, taking up especially the welfare and altruistic side of manufacturing; in demand as a lecturer on this and other subjects.

JACQUES BOYER *(Plaster Mining and Preparation in the Vicinity of Paris)*—Born in Paris, Dec. 6, 1869; educated at the Faculté des Sciences, Paris, 1890-1893; a regular contributor to *Cosmos, La Nature, La Revue Scientifique*, and many other periodicals in France and elsewhere; author of several

scientific books; member of the Association Française pour l'Avancement des Sciences and of the Société des Gens de Science; for some years past established as professor of engineering and consulting engineer at 5 bis Rue St. Paul, Paris.

LEON RAMAKERS *(The Elizabeth Eye-Bar Suspension Bridge at Budapest)*—A Belgian engineer, Docteur ès Sciences, resident in Brussels, and a frequent contributor to the technical press of Europe and America; specially engaged to report the technical and mechanical features of the exposition at Liége for THE ENGINEERING MAGAZINE, his review of which appeared in our issue for October last, and was widely noticed as one of the best synopses of the exhibition which had been presented.

FRANZ KOESTER *(A Quarter-Century of Electric Railway Engineering)*—Born in Sterkrade, Rhineland, the industrial center of Germany; at the age of 14, began engineering work at the foundation by entering the shops, part of his experience at this time being in construction; had three years' technical training and served a short time in the army; then took up again the profession of engineering, in the construction office of a general engineering concern; in 1899 entered the service of the Schuckert Company, Nuremberg, in the department of power-plant design, being connected also to some extent with railway work; during the three years he remained with this company he was intimately identified with the work on a number of plants, both steam and water-power, installed in Europe, Asia, and South and Central America; in 1902 removed to the United States and entered the mechanical engineering department of the Interborough Company (Rapid Transit Subway), New York, where he remained three and a half years; now connected with J. G. White & Company, of New York and London; a well-known contributor to the technical press on the generation, distribution, and utilization of power and on electric traction.

EGBERT P. WATSON *(The Changes of One Lifetime in the Machine Shop)*—Entered the Morgan Iron Works as apprentice, 1851, and afterwards employed in locomotive department of the Lowell, Mass., machine shop. On the closing of these works entered the employ of the Michigan Central R. R., and then followed the Lakes as a marine engineer for some years; returned to New York, entering the Novelty Iron Works, leaving this on invitation to join the editorial staff of the *Scientific American;* resigned this, on account of impaired health, to travel for a large steel-rail importing house; later established *The Mechanical Engineer*—afterwards called *The Engineer*—which enjoyed a certain popularity for nearly sixteen years. Now in consulting engineering practice.

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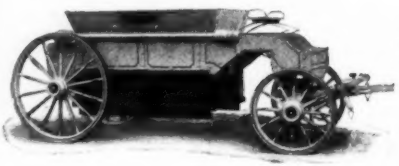

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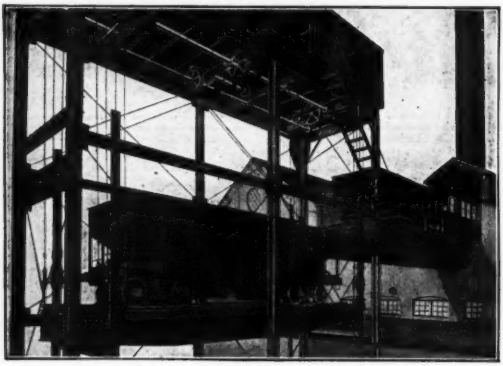

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INDEX TO ADVERTISEMENTS

A

Adams Co. 37
Ajax Mfg. Co. 38
Albany Steam Trap Co. 66
Albree Iron Wks., Chester B. 103
Alberger Condenser Co. 60
Allan & Son, A. 30
Allegheny Foundry Co. 86
Allis-Chalmers Co. 48
Almond Mfg. Co., T. R. 62
Alsen's American Portland Cement Co. 30
Alteneder & Sons, Theo. 115
Am. Air Compressor Works 71
American Ball Co. 44
American Blower Co. 50
American Cement Co. 102
Am. Diamond Rock Drill Co. 72
Am. District Steam Co. 10
American Engine Co. 51
American Gas Furnace Co. ... 28
American Locomotive Co. 109
American Mfg. Co. 25
Am. Railway Supply Co. 2
Am. Sheet & Tin Plate Co. .. 108
Am. Skylight & Iron Wks. ... 100
American Spiral Pipe Works 90
Am. Steam Gauge & Valve Mfg. Co. 2
Am. Steel Foundries. 76
Am. Tool & Machine Co. 123
Armstrong Mfg. Co. 42
Arnold Co. 118
Ashton Valve Co. 9
Atchison, Topeka & Santa Fe 110
Atlantic Works 106
Atlas Engine Works. ..... —
Atlas Portland Cement Co. .. 9
Austin Separator Co. 67

B

Babcock & Wilcox Co. 54
Baird & Co., Henry Carey. . 116
Baker-Vawter Co. 112
Baldwin Locomotive Wks. ... 109
Ball Bearing Co. 44
Ball Engine Co. 49
Barnes Co., W. F. & John. ... 40
Barnett Co., G. & H. 2
Becker-Brainard Milling Mch. Co. 37
Berlin Construction Co. 107
Bethlehem Foundry & Machine Co. 44
Bilgram, Hugo 45
Bird & Co., J. A. & W. 98
Birdsboro Steel Fdy. & Mch. Co. 39
Blake Mfg. Co., Geo. F. 89
Boston Belting Co. 69
Bourse, Philadelphia 6
Brandis Sons Co. 113
Brill, Geo. M. 117
Bristol Co. 124
Brooks & Co., T. H. 102
Browning Engineering Co. ... 80
Brown & Son, Edward. 53
Brown Hoisting Mchy. Co. ... 84
Buckeye Engine Co. 50
Bucyrus Co. 4
Buffalo Foundry Co. 76
Buff & Buff Mfg. Co. 115
Burke Machinery Co. 37
Burroughs Adding Machine Co. 114
Bushnell & Co., John S. 61

C

C & C Electric Co. 74
Caldwell & Son Co., H. W. . 81
Cameron Steam Pump Wks., A. S. 85
Carborundum Co. 34
Case Mfg. Co. 84
Casualty Co. of America. ... 3
Central R. R. of N. J. 74
Century Cement Machine Co. 100
Chaplin-Fulton Mfg. Co. 60
Chicago & Alton R. R. 111
Chicago, Burlington & Quincy R. R. 110
Chicago Drop Forge & Fdy. Co. 4
Chicago House Wrecking Co. 101
Chicago & Northwestern R.R. —
Chicago Pneumatic Tool Co. 39
Chicago, R. I. & P. Ry. 78
Chisholm & Moore Mfg. Co., 43-124
Cincinnati Shaper Co. 40
Clark, Jr., & Co., Jas. 47
Clarkson School of Technology 121
Cleveland Crane & Car Co. . 84
Cleveland Pneumatic Tool Co. 36
Clinton Wire Cloth Co. 93
"Compressed Air" 91
Continental Iron Works. 123
Contractors' Plant Mfg. Co. 82
Cooper, John A. 26
Coplay Cement Mfg. Co. 102
Cowing, John P. 6
Cox & Sons Co. 42
Crane Co. 54-64
Crocker-Wheeler Co. 47
Crosby Steam Gauge & Valve Co. 3
Curtis & Curtis Co. 40
Curtis & Co. Mfg. Co. 26-41
Cyclopean Co. 83

D

Dart Mfg. Co., E. M. 64
Davis Co., John. 63
Dayton Elec. Mfg. Co. 74
Dayton Hydraulic Mchy. Co. 87
Deane Steam Pump Co. 89
De Laval Steam Turbine Co. 52
De La Vergne Machine Co. . 53
D'Este Co., Julian. 61
Detroit Leather Specialty Co. 61
Diamond Chain & Mfg. Co. . 38
Diamond Saw & Stamping Co. 124
Diehl Mfg. Co. 74
Dietrich, C. A. 118
Dietzgen Co., Eugene. 113
Direct Separator Co. 67
Dixon Crucible Co., Joseph. . 9
Doble Co., Abner. 91
Dodge & Day. 117
Dunning, W. D. 104

E

East Jersey Pipe Co. 90
Edison Portland Cement Co. 103
Electric Controller & Supply Co. 75
Electric Vehicle Co. 116
Electric Welding Mfg. Co. . 102
Emerson Steam Pump Co. ... 86
Engelhard, Charles 77
Epping-Carpenter Co. 88
Erie R. R. 111
Eureka Fire Hose Co. 123
Evans-Wilkens & Co. 118
Everett Audit Co. 119

F

Fay & Egan Co., J. A. 46
Flagg & Co., Stanley G. 124
Flint & Walling Mfg. Co. ... 108
Flory Mfg. Co., S. 81
Foos Gas Engine Co. 53
Foster Engineering Co. 64
Fowler, George W. 118
Frick Co. 53
Furber, Wm. C. 118

G

Ganschow, Wm. 45
Gen. Compressed Air Co. 47
General Electric Co. 23
Gest, G. M. 10
Globe Mch. & Stamping Co. 76
Globe-Wernicke Co. 116
Goldschmidt-Thermit Co. ... 77
Goubert Mfg. Co. 67
Goulds Mfg. Co. 87
Green Engineering Co. 60
Green Fuel Economizer Co. . 57
Guild & Garrison. 31
Gunn-Richards & Co. 13-117

H

Hall Steam Pump Co. 71
Haller Machine Co. 6
Hancock Inspirator Co. 64
Harrison Safety Boiler Wks. 59
Hartford Steam Boiler Inspection & Ins. Co. 60
Harvard University 121
Hayward Co. 123
Heine Safety Boiler Co. 55
Hendrick Mfg. Co. ..... —
Hisey-Wolf Machine Co. 40
Hohmann & Maurer Mfg. Co. 3
Hooper, G. K. 117
Hooven, Owens, Rentschler Co. 51
Hoppes Mfg. Co. 58
Hudson Engineering & Contracting Co. 119
Hunt Co., C. W. 68
Hunt & Co., R. W. 117
Hydrex Felt & Eng. Co. 30

I

Illinois Central R. R. 111
Industrial Works 78
Ingersoll-Rand Co. 73
Interstate Engineering Co. .. 84

J

Jefferson Union Co. 6
Jeffrey Mfg. Co. 79
Jenkins Bros. 124
Jessop & Sons, Wm., Ltd. 41
Jones & Co., B. M. 30
Jones & Lamson Mch. Co. 40
Jour. Ass'n Eng. Societies. . 120

K

Kelley Island Lime & Transport Co. 102
Kennedy, Julian 119
Kennedy, Walter 117
Kerr Turbine Co. 5

INDEX TO ADVERTISEMENTS

Keuffel & Esser Co.....115
Kinnear Mfg. Co..... 30
Knowles Steam Pump Wks.. 89
Kolesch & Co.....113
Koppel Co., Arthur..... 79
Koven & Bro., L. O..... 70

L

Lafayette College 120
Lambert Hoisting Engine Co. 82
Landis Tool Co..... 37
Lawrence Machine Co..... 85
Lawrence Pump & Engine Co. 85
Lawrence Scientific School..121
Lehigh University 121
Lewis Institute 120
Lidgerwood Mfg. Co.....31-122
Link-Belt Engineering Co...104
Lombard Governor Co..... 91
Lord & Burnham Co.....100
Ludlow Valve Mfg. Co..... 10
Lufkin Rule Co.....115

M

McClure, Sons & Co., G. W..117
McGeorge & Sons..... 14
McGowan & Co., John H... 90
Manning, Maxwell & Moore 64
Mfrs. Advg. Bureau..... —
Marion Steam Shovel Co.... 3
Maris Bros. 36
Mass. Inst. of Technology...121
Maurer & Son, Henry..... 4
Mead-Morrison Mfg. Co..... 78
Mecklenburg Iron Works... 76
Merritt & Co..... 26
Michigan College of Mines..121
Miller-Collins Co. 94
Mineral Ridge Mfg. Co..... 82
Mississippi Wire Glass Co... 30
Model Stoker Co..... 54
Monon Route 112
Moore Corp., John C.....113
Moran Bros. 58
Morgan Construction Co.... 34
Morris Machine Works..... 87
Morse Twist Drill & Machine Co. 9
Moyer & Co., J. S..... 99
Myers & Bro., F. E..... 86

N

National-Acme Mfg. Co..... 41
National Machinery Co..... 38
National Pipe Bending Co.. 58
New Process Rawhide Co... 45
New York Central R. R....113
New York Engineering Agcy.119
Niagara Mch. & Tool Wks.. 42
Nicholson File Co..... 2
Niles-Bement-Pond Co. 29
Northampton Portland Cement Co. 103
Northern Electrical Mfg. Co. 74
Norwalk Iron Works Co.... 72
Norwich University 120
Nuttall Co., R. D..... 45

O

Obermayer Co. 77
Ostrander & Co., W. R..... 9

P

Palmer, W. K.....118
Parafine Paint Co..... 96
Pedrick & Ayer Co..... 42
Pelton Water Wheel Co.... 91
Penna. Military College.....121
Penna. State College.....120
Pennsylvania University ...121
Perry Time Stamp Co.....115
Petroleum Iron Works Co... 96
Phosphor Bronze Smelt. Co. 76
Pittsburg Gage & Supply Co. 59
Pittsburg Valve & Fittings Co. 63
Platt Iron Works Co..... 56
Poole Eng. & Mach. Co..... 9
Porter, H. F. J.....117
Porter Co., H. K.....109
Potter, F. D..... 66
Potter Separator Co..... 54
Power Specialty Co..... 6
Pratt Institute 120
Pratt & Whitney Co..... 28
Pray, Jr., Thomas.....118
Providence Eng'ng Works... 50

Q

Queen & Co., Inc.....113

R

Rail Joint Co.....109
Ransome Concrete Mchy. Co.105
Reeves Engine Co..... 52
Renssalaer Polytechnic Inst.120
Richardson Scale Co..... 81
Risdon Iron Works..... 72
Riter-Conley Mfg. Co..... 3
Robins Conveying Belt Co.. 79
Robb-Mumford Boiler Co., Inc. 55
Robbins & Myers Co..... 75
Robinson, A. W.....119
Rockwood Mfg. Co..... 61
Roebling Construction Co... 14
Roedder, O. C.....120
Roelker, H. B.....117
Roessler & Hasslacher Chemical Co. 72
Rose Polytechnic Institute..121
Ross Valve Co..... 59

S

Scaife & Sons Co., Wm. B.. 60
Scherzer Rolling Lift Bridge Co. 36
Schwerdtle Stamp Co..... 44
Sellers Co., Inc., Wm..... 41
Sheffield Scientific School...121
Shepherd Engineering Co... 52
Simmons Co., John..... 62
Simplex Elec. Heating Co... 74
Smidth & Co., F. L..... 70
Smith Foundry Supply Co., J. D. 76
Snow Steam Pump Works... 89
Southwark Fdy. & Mach. Co. 49
Sprague Electric Co..... 24
Standard Tool Co..... 39
Star Brass Mfg. Co..... 62
Star Drilling Machine Co... 72
Sterling Varnish Co..... 10
Stevens Inst. of Technology 120
Stewart Heater Co..... 58
Stocker, George J..... 53
Stoever Foundry & Mfg. Co. 42
Stow Flexible Shaft Co..... 46
Stow Manufacturing Co.... 41
Stromberg-Carlson Tel. Mfg. Co. 27
Struthers-Wells Co. 106
Stuebner Iron Works, G. L. 78
Sturtevant Co., B. F..... 51
Sullivan Machinery Co..... 71

T

Taylor Iron & Steel Co..... 14
Tippett & Wood.....108
Trenton Iron Co..... 71
Troy Wagon Works Co..... 8
Trussed Concrete Steel Co.. 97
Tucker & Vinton Corp..... 96
Tufts College 121
Turner Construction Co.... 95
Tyler Co., W. S..... 70

U

Underwood & Co., H. B.... 47
U. S. Cast Iron Pipe & Foundry Co. 90
U. S. Wood Preserving Co.. 35

V

Vanduzen Co., E. W..... 86
Vermont University 120
Von Schon, H.....119

W

Wagenhorst & Co., J. H.....113
Walsh's Holyoke Steam Boiler Works 106
Walworth Mfg. Co..... 4
Watson-Stillman Co. 88
Watson & McDaniel Co..... 66
Webster & Co., Warren.... 57
Webster Mfg. Co..... 80
Weeks, Edward M.....119
Wellman-Seaver-Morgan Co. 10
Westcott Co., Geo. F.....117
Western, Benj. R..... —
Westinghouse Air Brake Co. 32
Westinghouse Elec. & Mfg. Co. 32
Westinghouse Machine Co... 33
Weston Electrical Instrument Co. 31
Wetherill & Co., Robt..... 49
Wheeler Condenser & Eng'g Co. 56
White & Co., J. G.....119
Whitlock Coil Pipe Co..... 63
Wickes Bros. 55
Wile Power Gas Co..... 64
Williams Bros. 9
Williams Tool Co..... 42
Williams Valve Co., D. T... 65
Wisconsin University 120
Woodward Governor Co.... 90
Wood & Co., R. D..... 47
Worcester Polytechnic Institute 120
Worthington, Henry R..... 89
Wright Mfg. Co..... 66
Wyman & Gordon.....124

Y

Yale University 121

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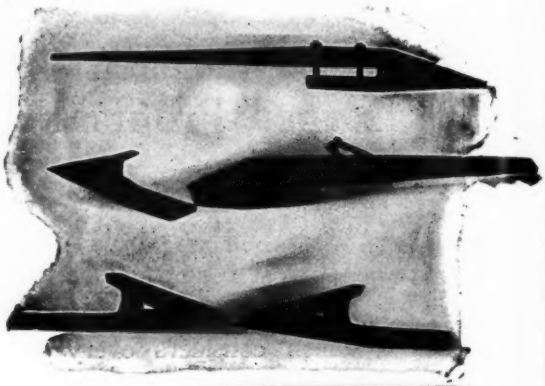

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Norwalk Iron Works, South Norwalk, Conn.
Pedrick & Ayer Co., Plainfield, N. J.
Platt Iron Works Co., Dayton.
Providence Eng. Wks., Providence.
Snow Steam Pump Wks., New York.
Sullivan Machinery Co., Chicago.
Henry R. Worthington, New York.

Air Brakes.
Westinghouse Air Brake Co., Pittsburg.

Air Compressors, Gasolene Driven.
General Compressed Air Co., St. Louis.

Air Drills.
Amer. Air Compressor Works, N. Y.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compressor Works, N. Y.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Air Hoists.
Amer. Air Compressor Works, N. Y.
Geo. F. Blake Mfg. Co., New York.
Chicago Pneu. Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Rand Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
Pedrick & Ayer Co., Plainfield, N. J.

Air Motors.
Amer. Air Compressor Works, N. Y.
Chicago Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.

Alumino-Thermics.
Goldschmidt Thermit Co., New York.

Ammeters.
Weston Elec. Inst., Co., Waverly Pk., Newark, N. J.

Annunciators.
W. R. Ostrander & Co., New York.

Anti-Friction Metals.
A. Allan & Son, New York.
Phosphor Bronze Smelting Co., Phila.
Poole Eng. & Mch. Co., Baltimore.

Architects.
Dodge & Day, Philadelphia.

Automatic Coal Weighing Machine.
Richardson Scale Co., New York.

Automobile Drop Forgings.
Chicago Drop Forge & Foundry Co., Kensington, Ill.

Automatic Sparker.
Dayton Elec. Mfg. Co., Dayton, O.

Automatic Time Stamps, Portable.
Perry Time Stamp Co., Chicago.

Ballast Unloaders.
Marion Steam Shovel Co., Marion, O.

Ball Bearings.
American Ball Co., Providence.
Ball Bearing Co., Philadelphia.

Band Saws.
Fay & Egan, Cincinnati.

Belt Conveyors.
H. W. Caldwell & Son Co., Chicago.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., New York.
Webster Mfg. Co., Chicago.

Belt Dressing (Waterproof).
Jos. Dixon Crucible Co., Jersey City.

Belting.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Engineering Co., Phila.
Pittsburg Gage & Supply Co., Pittsburg.
Robins Conveying Belt Co., N. Y.

Belt Lacing.
Bristol Co., Waterbury, Conn.

Belt Lacing Machines.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

Bending Rolls.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
William Sellers Co., Inc., Phila.

Blast Furnaces.
Walter Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
Riter-Conley Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.

Blowers.
Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
American Gas Furnace Co., N. Y.
Crocker-Wheeler Co., Ampere, N. J.
Green Fuel Economizer Co., Matteawan, N. Y.
Platt Iron Works, Dayton, Ohio.
J. D. Smith Fdy. Supply Co., Cleveland.
Sprague Electric Co., New York.
R. F. Sturtevant Co., Hyde Park, Mass.

Blowers, Turbine.
De Laval Steam Turbine Co., Trenton.

Blue Prints.
Kolesch & Co., New York.

Blue Print Machinery.
Buckeye Engine Co., Salem, O.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
J. H. Wagenhorst & Co., Youngstown, O.

Boiler Compounds.
John Simmons Co., New York.

Boiler Fronts and Fittings.
Continental Iron Works, Brooklyn.
Mecklenburg Iron Wks., Charlotte, N. C.
John Simmons Co., New York.
Walworth Mfg. Co., Boston.

Boiler Inspectors.
Casualty Co. of Amer., New York.
Hartford S. B. I. & Ins. Co., Hartford.

Boilers.
Atlantic Works, East Boston, Mass.
Atlas Engine Works, Indianapolis.
Babcock & Wilcox Co., New York.
East Jersey Pipe Co., New York.
Harrison Safety Boiler Wks., Phila.
Heine Safety Boiler Co., St. Louis.
Platt Iron Works, Dayton, Ohio.
Riter-Conley Mfg. Co., Pittsburg.
Robb-Mumford Boiler Co., So. Framingham, Mass.
Struthers-Wells Co., Warren, Pa.
Tippett & Wood, Phillipsburg, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.
Robt. Wetherill & Co., Chester, Pa.
Wickes Bros., Saginaw, Mich.

Boiler Tube Cleaners.
American Boiler Flue Cleaner Co., Trenton, N. J.

Bolt and Nut Machinery.
Ajax Mfg. Co., Cleveland.
National Machinery Co., Tiffin, O.
Niles-Bement-Pond Co., New York.

Bolt Threading Machines.
Ajax Mfg. Co., Cleveland.

Boring Bars.
Pedrick & Ayer Co., Plainfield, N. J.

Boring Mills.
Niles-Bement-Pond Co., New York.
William Sellers Co., Inc., Phila.

Boosters.
Allis-Chalmers Co., Milwaukee.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.

Brake Beams.
Am. Steel Foundries, New York.

Brakes—Friction.
Elec. Controller & Supply Co., Cleveland.

Brass Founders' Supplies.
Geo. F. Blake Mfg. Co., New York.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Brass Makers' Lathes.
Am. Tool & Machine Co., Boston.

Breast Drill, Electric.
Jas. Clark, Jr., & Co., Louisville.

Brick.
Henry Maurer & Son, New York.

Brick and Tile Machinery.
American Blower Co., Detroit.
Jeffrey Mfg. Co., Columbus.

Bridges.
Berlin Construction Co., Berlin, Conn.
Tucker & Vinton Corp., New York.

Bridges, Lift.
John P. Cowing, Cleveland.
Scherzer Rolling Lift Bridge Co., Chicago.

For Alphabetical Index to Advertisers see page 11.

Bucket Elevators.
Allis-Chalmers Co., Milwaukee.
Hayward Co., New York.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., New York.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Buckets, Bottom Dumping.
Cyclopean Co., Brooklyn.

Building Material, Second Hand.
Chicago House Wrecking Co., Chicago.

Buildings, Iron, Steel and Steel Concrete.
Berlin Construction Co., Berlin, Conn.
Miller-Collins Co., New York.
Tucker & Vinton Corp., New York.
Turner Construction Co., New York.

Bulldozers.
Ajax Mfg. Co., Cleveland.
National Mchy. Co., Tiffin, Ohio.
Niles-Bement-Pond Co., New York.

Business Systems.
Baker-Vawter Co., Chicago.
John A. Cooper, Chicago.
Everett Audit Co., Chicago.
Gunn, Richards & Co., New York.
John C. Moore Corp., Rochester.

Cable-Railway Machinery.
Mead-Morrison Mfg. Co., Boston.
Poole Eng'g & Mch. Co. ,Baltimore.
Robins Conveying Belt Co., New York.

Cables, Elec. & Submarine.
General Electric Co., New York.
Sprague Electric Co., New York.

Cableways—
(See Aerial Tramways.)

Cables, Wire.
Lidgerwood Mfg. Co., New York.
Trenton Iron Co., Trenton, N. J.

Caissons.
East Jersey Pipe Co., New York.

Calculating Machines.
Burroughs Adding Mch. Co., Detroit.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.

Carborundum.
Carborundum Co., Niagara Falls, N.Y.

Cars.
Arthur Koppel Co., New York.
Cleveland Crane & Car Co., Wickliffe, O.
Cyclopean Co., Brooklyn.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Wks., Charlotte, N. C.
Mineral Ridge Mfg. Co., Mineral Ridge, O.
Stuebner Iron Wks., Long Isld. City.

Car Shop Machinery.
Fay & Egan Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pedrick & Ayer Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford.

Castings, Iron, Steel & Brass.
Allegheny Fdy. Co., Ltd., Warren, Pa.
Am. Steel Foundries, New York.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Buffalo Foundry Co., Buffalo.
H. W. Caldwell & Son Co., Chicago.
Stanley G. Flagg & Co., Phila.
Goldschmidt Thermit Co., New York.
Jeffrey Mfg. Co., Columbus.
Mecklenburg Iron Works, Charlotte, N. C.
Poole Eng'g & Mch. Co., Baltimore.
John Simmons Co., New York.
Southwalk Fdy. & Mch. Co., Phila.
Walworth Mfg. Co., Boston.
Wellman-Seaver-Morgan Co., Cleveland.
Robt. Wetherill & Co., Chester, Pa.

Castings, Marine.
Am. Steel Foundries, New York.

Cast-Iron Pipe.
John Simmons Co., New York.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
R. D. Wood & Co., Phila.

Cement Machinery.
Allis-Chalmers Co., Milwaukee.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
H. W. Caldwell & Sons Co., Chicago.
W. D. Dunning, Syracuse, N. Y.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Ransome Concrete Mchy. Co., New York.
Robins Conveying Belt Co., New York.
F. L. Smidth & Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Cement, Portland.
Alsen's Am. Portland Cement Co., New York.
American Cement Co., Phila.
Atlas Portland Cement Co., N. Y.
Coplay Cement Mfg. Co., New York.
Edison Portland Cement Co., Philadelphia.
Kelley Isl. Lime & Trans. Co., Cleveland.
Northampton Portland Cement Co., New York.

Chains.
Diamond Chain & Mfg. Co., Indianapolis.

Chain Belting.
H. W. Caldwell & Sons Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.

Chain Hoist.
Chisholm & Moore Mfg. Co., Cleveland.

Channeling Machines.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Checks, Time, Pay & Trade.
American Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Chemicals.
Roessler & Hasslacher Chem. Co., New York.

Chemists.
Chas. Catlett, Staunton, Va.
Robt. W. Hunt & Co., Chicago.

Chucks.
Almond Mfg. Co., Brooklyn.
American Tool & Mch. Co., Boston.
Niles-Bement-Pond Co., New York.
Standard Tool Co., Cleveland.

Clutches, Magnetic.
Elec. Controller & Supply Co., Cleveland.

Clutch Pulleys.
H. W. Caldwell & Sons Co., Chicago.

Coal and Ashes-Handling Machinery.
Browning Eng'g Co., Cleveland.
H. W. Caldwell & Sons Co., Chicago.
Hayward Co., New York.
C. W. Hunt Co., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Coal Cutters (Air and Electric).
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Coal Scale.
Richardson Scale Co., New York.

Coal Weighing Machine, Automatic.
Richardson Scale Co., New York.

Coaling Towers.
Wheeler Condenser & Engineering Co., New York.

Coal-Mining Machinery.
Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
General Electric Co., New York.
C. W. Hunt Co., New York.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Engine Co., Newark.
Link-Belt Eng'g Co., Phila.
John H. McGowan Co., Cincinnati.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Norwalk Iron Wks., So. Norwalk, Ct.
Robins Conveying Belt. Co., N. Y.
Sullivan Machinery Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Henry R. Worthington, New York.

Coal Oil Furnaces.
Burke Machinery Co., Cleveland.

Coal Screens.
Allis-Chalmers Co., Milwaukee.
Hendrick Mfg. Co., Carbondale, Pa.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Robins Conveying Belt Co., New York.
W. S. Tyler Co., Cleveland.

Coil Pipe.
Whitlock Coil Pipe Co., Hartford.

Coke Oven Machinery.
Wellman-Seaver-Morgan Co., Cleveland.

Cold Saw Cutting-off Mchs.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

Concrete Block Machines.
Century Cement Machine Co., Rochester.

Concrete Mixers.
W. D. Dunning, Syracuse, N. Y.
Municipal Engineering & Contracting Co., Chicago.
Ransome Concrete Mchy. Co., New York.

Condensers.
Alberger Condenser Co., New York.
Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Epping-Carpenter Co., Pittsburg.
Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., N. Y.
John H. McGowan Co., Cincinnati.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
Wheeler Condenser & Engineering Co., New York.
Henry R. Worthington, New York.

Continuous Elevators.
H. W. Caldwell & Son Co., Chicago.

Contractors, General.
Miller-Collins Co., New York.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton Corp., New York.
Turner Construction Co., New York.
J. G. White & Co., New York.

Conduit Systems.
G. M. Gest, New York.

Controllers.
Elec. Controller & Supply Co., Cleveland.

Conveying Machinery.
Allis-Chalmers Co., Milwaukee.
Browning Eng'g Co., Cleveland.
H. W. Caldwell & Sons Co., Chicago.
Cleveland Crane & Car Co., Wickliffe, O.

For Alphabetical Index to Advertisers see page 11.

Frick Co., Waynesboro, Pa.
Hayward Co., New York.
C. W. Hunt Co., New York.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Maris Bros., Philadelphia.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Trenton Iron Co., Trenton, N. J.
Webster Mfg. Co., Chicago.
Wellman-Seaver-Morgan Co., Cleveland.

Cooling Towers.

Alberger Condenser Co., New York.
Cyclopean Co., Brooklyn.
George Stocker, St. Louis.
Wheeler Condenser & Engineering Co., New York.
Henry R. Worthington, New York.

Cordage.

American Mfg. Co., New York.

Corporation Counselors.

Everett Audit Co., Chicago.

Cost Systems.

Baker-Vawter Co., Chicago.
John A. Cooper, Chicago.
Everett Audit Co., Chicago.
Gunn, Richards & Co., New York.
G. K. Hooper, New York.

Cotton Oil Machinery.

Laidlaw-Dunn-Gordon Co., New York.
Platt Iron Works, Dayton, Ohio.

Couplings.

Almond Mfg. Co., Brooklyn.
Am. Steel Foundries, New York.

Cranes.

Browning Eng'g Co., Cleveland.
Case Mfg. Co., Columbus.
Cleveland Crane & Car Co., Wickliffe, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Maris Bros., Philadelphia.
Niles-Bement-Pond Co., New York
Pedrick & Ayer Co., Plainfield, N. J.
Riter-Conley Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
R. D. Wood & Co., Phila.

Crucibles.

Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Crusher, Ore, Phosphate, Rock.

Allis-Chalmers Co., Milwaukee.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
F. L. Smidth & Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Cupolas.

S. Obermayer Co., Cincinnati.
Riter-Conley Mfg. Co., Pittsburg.
J. D. Smith Fdy. Supply Co., Cleveland.

Cutters, Milling.

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Standard Tool Co., Cleveland.

Derricks and Fittings.

Contractors' Plant Mfg. Co., Buffalo.

Digesters.

Atlantic Works, East Boston, Mass.
Riter-Conley Mfg. Co., Pittsburg.
Tippett & Wood, Phillipsburg, Pa.
Robt. Wetherill & Co., Chester, Pa.

Draft, Mechanical.

B. F. Sturtevant Co., Hdye Park, Mass.

Drilling Machines.

W. F. & J. Barnes Co., Rockford, Ill.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Chicago Pneu. Tool Co., Chicago.
Jos. Clark, Jr., & Co., Louisville.
Cleveland Pneu. Tool Co., Cleveland.
Hisey-Wolf Mch. Co., Cincinnati.
Ingersoll-Rand Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Drills, Diamond Core.

Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago.

Drills—Rock and Coal.

Am. Diamond Rock Drill Co., New York.
Chicago Pneumatic Tool Co., Chicago.
Clayton Air Compress Wks., N. Y.
Hall Steam Pump Co., Pittsburg.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Sullivan Machinery Co., Chicago.

Drop Forgings.

Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Wyman & Gordon, Worcester, Mass.

Drying Apparatus.

B. F. Sturtevant Co., Hdye Park, Mass.

Dumping Buckets.

Cyclopean Co., Brooklyn.

Dumps, Automatic.

Sullivan Machinery Co., Chicago.

Dump Wagons.

Troy Wagon Works Co., Troy, Ohio.

Dynamos.

Allis-Chalmers Co., Milwaukee.
Am. Engine Co., Bound Brook, N. J.
Crocker-Wheeler Co., Ampere, N. J.
C & C Electric Co., New York.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, O.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Dynamos, Steam Turbine.

De La Val Steam Turbine Co., Trenton.

Elbows, Pipe.

Whitlock Coil Pipe Co., Hartford.

Electrical Measuring Instruments.

Weston Elec. Instrument Co., Waverly Park, Newark.

Electric Bells.

W. R. Ostrander & Co., New York.

Electric Bucket Trolleys.

Browning Engineering Co., Cleveland.

Electric Heating Apparatus.

Simplex Elec. Heating Co., Cambridgeport, Mass.

Electric Hoists.

Allis-Chalmers Co., Milwaukee.
Browning Eng'g Co., Cleveland.
C & C Electric Co., New York.
C. W. Hunt Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., Boston.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Niles-Bement-Pond Co., New York.
Sprague Electric Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Electric Signs.

Haller Machine Co., Chicago.

Elec. Welding Outfits.

C & C Electric Co., New York.

Electrical Laboratory Furnaces.

Charles Engelhard, New York.

Elevators.

Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Son Co., Chicago.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
S. Obermayer Co., Cincinnati.
Poole Eng'g & Mch. Co., Baltimore.

Emery Wheels.

Carborundum Co., Niagara Falls.
Stow Flexible Shaft Co., Phila.

Engineering Instruments.

Theo. Alteneder & Sons, Phila.
Bandis Sons Co., Brooklyn.
Buff & Buff Mfg. Co., Boston.
Eugene Dietzgen Co., Chicago.
Keuffel & Esser Co., New York.
Kolesch & Co., New York.
Queen & Co., Phila.

Engineers.

Arnold Co., Chicago.
George M. Brill, Los Angeles.
Abner Doble Co., San Francisco.
Dodge & Day, Philadelphia.
Geo. W. Fowler, Poughkeepsie, N. Y.
Wm. C. Furber, Philadelphia.
Gunn, Richards & Co., New York.
G. K. Hooper, New York.
Hudson Eng. & Cont. Co., New York.
Robt. W. Hunt & Co., Chicago.
Julian Kennedy, Pittsburg.
Walter Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
H. F. J. Porter, New York.
W. K. Palmer, Kansas City.
Power Installation Co., Buffalo.
Thomas Pray, Jr., Boston.
A. W. Robinson, Montreal, Canada.
H. B. Roelker, New York.
H. Von Schon, Detroit.
Wellman-Seaver-Morgan Co., Cleveland.
J. G. White & Co., New York.

Engines, Blowing.

Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Platt Iron Works, Dayton, Ohio.
Southwark Fdy. & Mch. Co., Phila.
Sprague Elec. Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Engines, Marine.

Atlantic Works, East Boston, Mass.
Moran Bros., Seattle, Wash.

Engines—Gas and Gasoline.

Allis-Chalmers Co., Milwaukee.
De La Vergne Machine Co., N. Y.
Foos Gas Eng. Co., Springfield, O.
Snow Steam Pump Wks., New York.
Struthers-Wells Co., Warren, Pa.
Westinghouse Mch. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse, Church, Kerr & Co., New York.

Engines, Steam.

Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Am. Engine Co., Bound Brook, N. J.
Atlas Engine Works, Indianapolis.
Ball Engine Co., Erie, Pa.
Geo. F. Blake Mfg. Co., New York.
Buckeye Engine Co., Salem, O.
Frick Co., Waynesboro, Pa.
Hooven, Owens, Rentschler Co., Hamilton.
Mecklenburg Iron Wks., Charlotte, N. C.
Providence Eng'g Wks., Providence.
Reeves Engine Co., New York.
Shepherd Eng'g Co., Franklin, Pa.
Southwark Fdy. & Mch. Co., Phila.
Struthers-Wells Co., Warren, Pa.
B. F. Sturtevant Co., Hyde Park, Mass.
Wellman-Seaver-Morgan Co., Cleveland.
Westinghouse Mch. Co., Pittsburg.
Westinghouse, Church, Kerr & Co., New York.
Robt. Wetherill & Co., Chester, Pa.

Evaporators.

Geo. F. Blake Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.

Excavators.

Allis-Chalmers Co., Milwaukee.
Bucyrus Co., So. Milwaukee, Wis.
Hayward Co., New York.
Jeffrey Mfg. Co., Columbus.
Marion Steam Shovel Co., Marion, O.

For Alphabetical Index to Advertisers see page 11.

Municipal Engineering & Contracting Co., Chicago.
Robins Conveying Belt Co., N. Y.

Exhaust Heads.

Am. Spiral Pipe Wks., Chicago.
Direct Separator Co., Syracuse.
Hoppes Mfg. Co., Springfield, O.
Pittsburg Gage & Supply Co., Pittsburg.
B. F. Sturtevant Co., Hyde Park, Mass.
Watson & McDaniel Co., Phila.
Wright Mfg. Co., Detroit.

Factory Telephone Systems.

Stromberg-Carlson Tel. Mfg. Co., Rochester.

Fans, Ventilating.

Allis-Chalmers Co., Milwaukee.
American Blower Co., Detroit.
Green Fuel Economizer Co., Matteawan, N. Y.
Power-Specialty Co., New York.
Sprague Electric Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.
Sullivan Machinery Co., Chicago.

Fans, Electric,

Diehl Mfg. Co., Elizabethport, N. J.

Feed-Water Heaters and Purifiers.

Allis-Chalmers Co., Milwaukee.
Geo. F. Blake Mfg. Co., New York.
Goubert Mfg. Co., New York.
Green Fuel Economizer Co., Matteawan, N. Y.
Harrison Safety Boiler Wks., Phila.
Knowles Steam Pump Wks., N. Y.
Hoppes Mfg. Co., Springfield, O.
John H. McGowan Co., Cincinnati.
National Pipe Bend. Co., New Haven.
The Petroleum Iron Works Co., Washington, Pa.
Platt Iron Works Co., Dayton.
Providence Eng'g Wks., Providence.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Stewart Heater Co., Buffalo.
Warren Webster & Co., Camden, N.J.
Whitlock Coil Pipe Co., Hartford.
Robt. Wetherill & Co., Chester, Pa.
Wheeler Condenser & Engineering Co., New York.
Henry R. Worthington, New York.

Felt, Waterproof.

Hydrex Felt & Eng'g Co., New York

Files and Rasps.

G. & H. Barnett Co., Phila.
Nicholson File Co., Providence.

Filing Cabinets.

Globe-Wernicke Co., Cincinnati.

Filter Presses,

Am. Tool & Machine Co., Boston.

Filters.

L. O. Koven & Bro., New York.
Ross Valve Co., Troy.
Wm. B. Scaife & Sons Co., Pittsburg.
Robt. Wetherill & Co., Chester, Pa.

Fire Brick.

Henry Maurer & Son, New York.
S. Obermayer Co., Cincinnati.
J. D. Smith Fdy. Supply Co., Cleveland.

Fireproof Building Materials.

Clinton Wire Cloth Co., New York.
Henry Maurer & Son, New York.
Roebling Construction Co., New York.

Flanges.

Am. Spiral Pipe Wks., Chicago.
E. M. Dart Mfg. Co., Providence.
Jefferson Union Co., Lexington, Mass.

Flexible Shafts.

Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.

Flexible Steel Tubing.

Almond Mfg. Co., Brooklyn.

Float Valves.

Foster Eng'g Co., Newark.

Floor and Sidewalk Lights.

T. H. Brooks & Co., Cleveland.

Fly Wheels.

Allis-Chalmers Co., Milwaukee.
Poole Eng'g & Mch. Co., Baltimore.
Robt. Wetherill & Co., Chester, Pa.

Forges.

Ingersoll-Rand Co., New York.
B. F. Sturtevant Co., Hyde Park, Mass.

Forgings, Iron and Steel.

Chester B. Albree, Allegheny, Pa.
Chicago Drop Forge & Fdy. Co., Kensington, Ill.
Wyman & Gordon, Worcester.

Foundry Improvements.

Goldschmidt Thermit Co., New York.

Foundry Equipment.

Am. Air Compressor Wks., New York.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Geo. F. Blake Mfg. Co., New York.
Buffalo Foundry Co., Buffalo.
Globe Mch. & Stamping Co., Cleveland.
C. W. Hunt Co., New York.
Ingersoll-Rand Co., New York.
Arthur Koppel Co., New York.
S. Obermayer Co., Cincinnati.
Pedrick & Ayer Co., Plainfield, N. J.
J. D. Smith Fdy. Supply Co., Cleveland.
Wellman-Seaver-Morgan Co., Cleveland.

Foundry Supplies.

Ingersoll-Rand Co., New York.
S. Obermayer Co., Cincinnati.

Friction Clutches.

Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Son Co., Chicago.
Elec. Controller & Supply Co., Cleveland.
Link-Belt Eng'g Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Fuel Economizers.

Green Fuel Economizer Co., Matteawan, N. Y.
Providence Eng'g Wks., Providence.
B. F. Sturtevant Co., Hyde Park, Mass.

Furnace Builders.

Am. Gas Furnace Co., New York.
Burke Machinery Co., Cleveland.
Continental Iron Wks., Brooklyn.
Julian Kennedy, Pittsburg.
G. W. McClure, Son & Co., Pittsburg.
Morgan Const. Co., Worcester.
Riter-Conley Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.

Gages — Pressure, Steam, Water.

Am. Steam Gauge & Valve Co., Boston
Ashton Valve Co., Boston.
Bristol Co., Waterbury, Conn.
Crosby Steam Gage & Valve Co., Boston.
Hohmann & Maurer Mfg. Co., Rochester.
Manning, Maxwell & Moore, N. Y.
Pittsburg Gage & Supply Co., Pittsburg.
John Simmons Co., New York.
Star Brass Mfg. Co., Boston.
Walworth Mfg. Co., Boston.

Galvanizing.

L. O. Koven & Bro., New York.
John Simmons Co New York.

Gas Machines & Generators.

Am. Gas Furnace Co., New York.
Link-Belt Eng'g Co., Phila.
Morgan Const. Co., Worcester.
Wile Power Gas Co., Rochester.
R. D. Wood & Co., Phila.
Walworth Mfg. Co., Boston.

Gas Blowers and Exhausters.

B. F. Sturtevant Co., Hyde Park, Mass.

Gas Producers.

Morgan Construction Co., Worcester.
Wile Power Gas Co., Rochester.

Gaskets.

Am. Spiral Pipe Wks., Chicago.
Boston Belting Co., Boston.

Gear Cutting Machines.

Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.

Gearing.

Hugo Bilgram, Phila.
Geo. F. Blake Mfg. Co., New York.
H. W. Caldwell & Son Co., Chicago.
Wm. Ganschow, Chicago.
Jeffrey Mfg. Co., Columbus.
New Process Rawhide Co., Syracuse.
R. D. Nuttall Co., Pittsburg.
Poole Eng'g & Mch. Co., Baltimore.
Wm. Sellers Co., Inc., Phila.
Stow Flexible Shaft Co., Phila.
Robt. Wetherill & Co., Chester, Pa.

Generating Sets.

Allis-Chalmers Co., Milwaukee.
B. F. Sturtevant Co., Hyde Park, Mass.

Gold Dredging Machinery.

Allis-Chalmers Co., Milwaukee.
Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.
Risdon Iron Works, San Francisco.

Graphite.

J. D. Smith Fdy. Supply Co., Cleveland.

Grates, Traveling Link.

Green Engineering Co., Chicago.

Grinding & Polishing Mchy.

Becker-Brainard Milling Machine Co., Hyde Park, Mass.
Jas. Clarke, Jr., & Co., Louisville.
Crocker-Wheeler Co., Ampere, N. J.
Hisey-Wolf Mch. Co., Cincinnati.
Landis Tool Co., Waynesboro, Pa.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison.
Pratt & Whitney Co., Hartford.
F. L. Smidth & Co., New York.
Stow Flexible Shaft Co., Phila.
William Sellers Co., Inc., Phila.

Hack Saws.

Diamond Saw & Stamping Works, Buffalo.

Hammers, Electric.

Northern Elec. Mfg. Co., Madison, Wis.

Hand Drill—Electric.

Hisey-Wolf Mch. Co., Cincinnati.

Heading & Upsetting Mchy.

National Mchy. Co., Tiffin, Ohio.

Heating and Ventilating Apparatus.

American Blower Co., Detroit.
American District Steam Co., Lockport, N. Y.
Manning, Maxwell & Moore, N. Y.
John Simmons Co., New York.
Sprague Elec. Co., New York.
Stewart Heater Co., Buffalo.
B. F. Sturtevant Co., Hyde Park, Mass.
Walworth Mfg. Co., Boston.
Warren Webster & Co., Camden, N. J.

High Pressure Steel Fittings.

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

Hoisting Engines and Mchy.

Allis-Chalmers Co., Milwaukee.
Brown Hoist. Mch. Co., New York.
Browning Eng'g Co., Cleveland.
Case Mfg. Co., Columbus, O.
Contractors' Plant Mfg. Co., Buffalo.
S. Flory Mfg. Co., Bangor, Pa.
Hayward Co., New York.
C. W. Hunt Co., New York.
Industrial Wks., Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Jeffrey Mfg. Co., Columbus.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Providence Eng'g Works, Providence.
Robins Conveying Belt Co., New York.

For Alphabetical Index to Advertisers see page II.

William Sellers Co., Inc., Phila.
Sprague Elec. Co., New York.
Stuebner Iron Wks., Long Isld. City.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton, N. J.
Wellman-Seaver-Morgan Co., Cleveland.

Hoisting Rope.

American Mfg. Co., New York.

Hollow Concrete Building Block Machines.

Century Cement Machine Co., Rochester.

Hose.

Chicago Pneumatic Tool Co., Chicago.
Boston Belting Co., Boston.
Eureka Fire Hose Co., New York.

Hydraulic Machinery.

Allis-Chalmers Co., Milwaukee.
Dayton Hydraulic Mchy. Co., Dayton.
Goulds Mfg. Co., Seneca Falls, N. Y.
Platt Iron Works, Dayton, Ohio.

Hydraulic Rams.

Pelton Water Wheel Co., 'Frisco.
Power Specialty Co., New York.

Ice-Mak'g & Refriger. Mchy.

De La Vergne Machine Co., N. Y.
Frick Co., Waynesboro, Pa.
H. B. Roelker, New York.

Indicators.

American Steam Gauge & Valve Mfg. Co., Boston.
John S. Bushnell & Co., New York.
Crosby Steam Gage & Valve Co., Boston.

Injectors.

Hayden & Derby Mfg. Co., N. Y.
John Simmons Co., New York.

Internal Gearing.

Wm. Ganschow, Chicago.
R. D. Nuttall Co., Pittsburg.

Iron and Bronze, Ornamental.

W. S. Tyler Co., Cleveland.

Iron, Yorkshire.

B. M. Jones & Co., Inc., Boston.

Jacks, Hydraulic.

Watson-Stillman Co., New York.

Lamps, Electric.

General Electric Co., New York.
Sawyer-Man Elec. Co., Pittsburg.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Larries.

Mineral Ridge Mfg. Co., Mineral Ridge, O.

Lathes.

American Tool & Mch. Co., Boston.
W. F. & J. Barnes Co., Rockford, Ill.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.

Leather Packing.

Detroit Leather Specialty Co., Detroit.

Lift Bridges.

John P. Cowing, Cleveland.
Scherzer Rolling Lift Bridge Co., Chicago.

Lifting Magnets.

Elec. Controller & Supply Co., Cleveland.

Light Railways.

C. W. Hunt Co., New York.
Arthur Koppel Co., New York.
Link-Belt Eng'g Co., Phila.
Robins Conveying Belt Co., New York.
Stuebner Iron Wks., Long Isld. City.

Lock-Bar Steel Pipe.

East Jersey Pipe Co., New York.

Lockers.—Metal.

Merritt & Co., Phila.

Locomotive Axles.

B. M. Jones & Co., Inc., Boston.

Locomotive Cranes.

Browning Eng'g Co., Cleveland.
Industrial Wks., Bay City, Mich.
Interstate Eng'g Co., Cleveland.
Mead-Morrison Mfg. Co., Boston.
Wellman-Seaver-Morgan Co., Cleveland.

Locomotives.

American Locomotive Co., New York.
Baldwin Locomotive Wks., Phila.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
H. K. Porter Co., Pittsburg.
Robins Conveying Belt Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Lubricants.

Jos. Dixon Crucible Co., Jersey City.
S. Obermayer Co., Cincinnati.

Lubricating & Oiling Devices.

E. M. Dart Mfg. Co., Providence.
Pittsburg Gage & Supply Co., Pittsburg.

Lubricators.

D. T. Williams Valve Co., Cincinnati.

Machinery Exhibits.

Bourse, Philadelphia.

Machinery, Second Hand.

Chicago House Wrecking Co., Chicago.

Machinists' Small Tools.

Morse Twist Drill & Mch. Co., New Bedford, Mass.
Pratt & Whitney Co., Hartford.
William Sellers Co., Inc., Phila.
Standard Tool Co., Cleveland.

Manganese Steel.

Taylor Iron & Steel Co., High Bridge, N. J.

Measuring Tapes.

Kolesch & Co., New York.
Lufkin Rule Co., Saginaw, Mich.

Metals.

A. Allan & Son, New York.

Metals, Carbonless.

Goldschmidt Thermit Co., New York.

Metallic Valve Discs.

A. Allan & Son, New York.

Meters, Electric.

General Electric Co., New York.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Weston Elec. Inst. Co., Waverly Park, N. J.

Milling Machines.

Adams Co., Dubuque, Iowa.
Becker-Brainard Mill. Mch. Co., Hyde Park, Mass.
Burke Machinery Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Mill Supplies.

Mineral Ridge Mfg. Co., Mineral Ridge, O.
Pittsburg Gage & Supply Co., Pittsburg.
Robins Conveying Belt Co., New York.

Mine Cars.

Allis-Chalmers Co., Milwaukee.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Arthur Koppel Co., New York.
Wellman-Seaver-Morgan Co., Cleveland.

Mining Machinery.

Allis-Chalmers Co., Milwaukee.
Am. Diamond Rock Drill Co., N. Y.
Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
General Electric Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Ingersoll-Rand Co., New York.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.
Arthur Koppel Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
John H. McGowan Co., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Wks., Charlotte, N. C.
Mineral Ridge Mfg. Co., Mineral Ridge, Ohio.
Norwalk Iron Wks., So. Norwalk, Ct.
Platt Iron Works, Dayton, Ohio.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.
Risdon Iron Works, San Francisco.
Robins Conveying Belt Co., N. Y.
F. L. Smidth & Co., New York.
Snow Steam Pump Wks., New York.
Sullivan Machinery Co., Chicago.
Trenton Iron Wks. Co., Trenton, N. J.
Westinghouse Elec. & Mfg. Co., Pittsburg.
Wellman-Seaver-Morgan Co., Cleveland.
Henry R. Worthington, New York.

Motors, Electric.

Allis-Chalmers Co., Milwaukee.
Am. Engine Co., Bound Brook, N. J.
C & C Electric Co., New York.
Crocker-Wheeler Co., Ampere, N. J.
Diehl Mfg. Co., Elizabethport, N. J.
Elec. Controller & Supply Co., Cleveland.
General Electric Co., New York.
Jeffrey Mfg. Co., Columbus.
Northern Elec. Mfg. Co., Madison, Wis.
Robbins & Myers Co., Springfield, O.
Sprague Electric Co., New York.
Stow Mfg. Co., Binghamton, N. Y.
B. F. Sturtevant Co., Hyde Park, Mass.
Westinghouse Elec. & Mfg. Co., Pittsburg.

Motors, Steam Turbine.

De La Val Steam Turbine Co., Trenton.

Moulding Machines.

Geo. F. Blake Mfg. Co., New York.
S. Obermayer Co., Cincinnati.
Power Specialty Co., New York.
J. D. Smith Fdy. Supply Co., Cleveland.

Name Plates and Labels.

Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Naphtha Gas Machines.

Am. Gas Furnace Co., New York.

Nut Tappers.

National Mchy. Co., Tiffin, Ohio.

Office Furniture.

Globe-Wernicke Co., Cincinnati.

Oil Burners.

The Petroleum Iron Works Co., Washington, Pa.

Oil Engines.

De La Vergne Machine Co., N. Y.

Oil Filters.

Pittsburg Gage & Supply Co., Pittsburg.

Oil Furnaces.

Burke Machinery Co., Cleveland.

Oil Refining Plants.

The Petroleum Iron Works Co., Washington, Pa.

Packing.

Boston Belting Co., Boston.
Chaplin-Fulton Mfg. Co., Pittsburgh.
Detroit Leather Specialty Co., Detroit.
Jenkins Brothers, New York.

Paint Graphite.

S. Obermayer Co., Cincinnati.

Paints and Varnishes.

Jos. Dixon Crucible Co., Jersey City.
Paraffine Paint Co., San Francisco.
Sterling Varnish Co., Pittsburg.

Paper-Mill Machinery.

Geo. F. Blake Mfg. Co., New York.
Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Jeffrey Mfg. Co., Columbus.
Knowles Steam Pump Wks., N. Y.

For Alphabetical Index to Advertisers see page 11.

Laidlaw-Dunn-Gordon Co., New York.
Robins Conveying Belt Co., New York.
Snow Steam Pump Wks., New York.
Henry R. Worthington, New York.

Patent Attorneys.

C. A. Dieterich, New York.
Edw. M. Weeks, Washington, D. C.
Evans, Wilkins & Co., Washington, D. C.

Pattern-Makers' Machinery.

Fay & Egan Co., Cincinnati.
Pratt & Whitney Co., Hartford.
J. D. Smith Fdy. Supply Co., Cleveland.

Pattern Makers.

Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.

Penstocks.

Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Perforated Metal.

Allis-Chalmers Co., Milwaukee.
H. W. Caldwell & Son Co., Chicago.
Hendrick Mfg. Co., Carbondale, Pa.

Phosphor Bronze.

Phosphor Bronze Smelt. Co., Phila.
Poole Eng'g & Mch. Co., Baltimore.

Pile Drivers.

Bucyrus Co., So. Milwaukee.
Ingersoll-Rand Co., New York.
Interstate Eng'g Co., Cleveland.

Pipe.

Am. Spiral Pipe Wks., Chicago.
East Jersey Pipe Co., New York.
L. O. Koven & Bro., New York.
National Pipe Bend. Co., New Haven.
Pelton Water Wheel Co., 'Frisco.
The Petroleum Iron Works Co., Washington, Pa.
Pittsburg Gage & Supply Co., Pittsburg.
John Simmons Co., New York.
U. S. Cast Iron Pipe & Fdy. Co., Phila.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe Bends.

National Pipe Bend. Co., New Haven.
Walworth Mfg. Co., Boston.
Whitlock Coil Pipe Co., Hartford.

Pipe-Cutting and Threading Machines.

Armstrong Mfg. Co., Bridgeport, Conn.
Cox & Sons Co.,Bridgeton, N. J.
Curtis & Curtis Co., Bridgeport, Ct.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
John Simmons Co., New York.
Stoever Foundry & Mfg. Co., Myerstown, Pa.
Walworth Mfg. Co., Boston.
Williams Tool Co., Erie, Pa.

Pipe Fittings, Cast-Iron.

American Spiral Pipe Wks., Chicago.
Pelton Water Wheel Co., San Francisco.
Pittsburg Gage & Supply Co., Pittsburg.
Pittsburgh Valve & Fittings Co., Pittsburgh.
John Simmons Co., New York.
Walworth Mfg. Co., Boston.

Piston Rods.

B. M. Jones & Co., Inc., Boston.

Planers.

Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Planing Mill Machinery.

Fay & Egan Co., Cincinnati.

Pneumatic Tools.

Am. Air Compress. Wks., N. Y.
Chicago Pneu. Tool Co., Chicago.
Clayton Air Compress. Wks., N. Y.
Cleveland Pneu. Tool Co., Cleveland.
Curtis & Co. Mfg. Co., St. Louis.
Ingersoll-Rand Co., New York.

Pop Safety Valves.

Am. Steam Gauge & Valve Co., Boston.
Ashton Valve Co., Boston.
Consolidated Safety Valve Co., N. Y.
Crosby Steam Gauge & Valve Co., Boston.
Star Brass Mfg. Co., Boston.

Portable Drilling Machines.

Ingersoll-Rand Co., New York.
Star Drilling Machine Co., Akron, O.

Portable Time Stamps and Recorders.

Perry Time Stamp Co., Chicago.

Power Machinery, Steam or Water.

Allis-Chalmers Co., Milwaukee.
Wellman-Seaver-Morgan Co., Cleveland.

Power-Transmission Mchy.

Allis-Chalmers Co., Milwaukee.
H. W. Caldwell & Son Co., Chicago.
Case Mfg. Co., Columbus.
Crocker-Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Hayward Co., New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Mead-Morrison Mfg. Co., Boston.
Mecklenburg Iron Wks., Charlotte, N. C.
Niles-Bement-Pond Co., New York.
Northern Elec. Mfg. Co., Madison, Wis.
Platt Iron Works Co., Dayton.
Robins Conveying Belt. Co., N. Y.
Sprague Electric Co., New York.
Webster Mfg. Co., Chicago.
Westinghouse Elec. & Mfg. Co., Pittsburg.
R. D. Wood & Co., Phila.

Presses and Dies.

Curtis & Curtis Co., Bridgeport.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.
Watson-Stillman Co., New York.
R. D. Wood & Co., Phila.

Production Engineers.

Everett Audit Co., Chicago.
Gunn, Richards & Co., New York.

Prospecting Drills.

Am. Diamond Rock Drill Co., N. Y.
Ingersoll-Rand Co., New York.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago.

Pulleys, Shafting & Hangers.

Allis-Chalmers Co., Milwaukee.
Am. Tool & Mch. Co., Boston.
H. W. Caldwell & Sons Co., Chicago.
Fay & Egan, Cincinnati.
Jeffrey Mfg. Co., Columbus.
Niles Tool Works Co., New York.
Poole Eng'g & Mch. Co., Baltimore.
Robins Conveying Belt Co., N. Y.

Pump Governors.

Albany Steam Trap Co., Albany.

Pumps and Pumping Mchy.

Albany Steam Trap Co., Albany.
Alberger Condenser Co., New York.
Allegheny Foundry Co., Ltd., Warren, Pa.
Allis-Chalmers Co., Milwaukee.
Ashcroft Mfg. Co., New York.
Geo. F. Blake Mfg. Co., New York.
Bucyrus Co., So. Milwaukee.
Cameron Steam Pump Wks., N. Y.
Clayton Air Compress. Wks., N. Y.
Dayton Hydraulic Mchy. Co., Dayton.
Deane Steam Pump Co., New York.
De La Val Steam Turbine Co., Trenton.
Emerson Steam Pump Co., Alexandria, Va.
Epping-Carpenter Co., Pittsburg.
Flint & Walling Mfg. Co., Kendallville, Ind.
Goulds Mfg. Co., Seneca Falls, N. Y.
Guild & Garrison, Brooklyn.
Hall Steam Pump Co., Pittsburg.
Holly Mfg. Co., New York.
Ingersoll-Rand Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Lawrence Pump & Eng. Co., Lawrence, Mass.
John H. McGowan Co., Cincinnati.
Mecklenburg Iron Wks., Charlotte, N. C.
Morris Mch. Wks., Baldwinsville, N. Y.
F. E. Myers & Bro., Ashland, O.
Platt Iron Works Co., Dayton.
Providence Eng'g Wks., Providence.
Snow Steam Pump Wks., New York.
Southwark Fdy. & Mch. Co., Phila.
E. W. Vanduzen Co., Cincinnati.
Watson-Stillman Co., New York.
Robt. Wetherill & Co., Chester, Pa.
Wheeler Condenser & Engineering Co., New York.
R. D. Wood & Co., Phila.
Henry R. Worthington, New York.

Pumps, Syphon.

Chaplin- Fulton Mfg. Co., Pittsburgh.

Punching & Shearing Mchy.

Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Morgan Const. Co., Worcester.
National Machinery Co., Tiffin, O.
Niagara Mch. & Tool Wks., Buffalo.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford, Conn.
R. D. Wood & Co., Phila.

Pyrometers.

Edward Brown & Son, Philadelphia.
Charles Engelhard, New York.
Queen & Co., Philadelphia.

Quarry Machinery.

S. Flory Mfg. Co., Bangor, Pa.
Ingersoll-Rand Co., New York.
Lambert Hoist. Eng. Co., Newark.
Lidgerwood Mfg. Co., New York.
John H. McGowan Co., Cincinnati.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.
Star Drilling Machine Co., Akron, O.
Sullivan Machinery Co., Chicago.
Trenton Iron Co., Trenton.

Quartz Laboratory Ware.

Charles Engelhard, New York.

Quartz Mercury Lamps.

Charles Engelhard, New York.

Racks—Machine Cut.

Wm. Ganschow, Chicago.
R. D. Nuttall Co., Pittsburg.

Radiators.

John Simmons Co., New York.

Rail Braces.

Rail Joint Co., New York.

Rail Joints.

Rail Joint Co., New York.
Goldschmidt Thermit Co., New York.

Railway Castings and Forgings.

Am. Steel Foundries, New York.
B. M. Jones & Co., Inc., Boston.

Railway Shop Machinery.

Chester B. Albree, Allegheny, Pa.
W. F. & J. Barnes Co., Rockford, Ill.
Clayton Air Compress. Wks., N. Y.
Fay & Egan Co., Cincinnati.
Ingersoll-Rand Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
National Machinery Co., Tiffin, Ohio.
Niles-Bement-Gordon Co., New York.
Norwalk Iron Wks., So. Norwalk, Ct.
Pedrick & Ayer Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford.
Stow Flexible Shaft Co., Phila.
Stow Mfg. Co., Binghamton, N. Y.
H. B. Underwood & Co., Phila.
Watson-Stillman Co., New York.

Rawhide Gears.

New Process Raw Hide Co., Syracuse.

Reamers.

Chicago Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Standard Tool Co., Cleveland.

For Alphabetical Index to Advertisers see page 11.

Reinforced Concrete Steel.
Electric Welding Mfg. Co., Pittsburg.

Resistance Banks and Units.
Elec. Controller & Supply Co., Cleveland.

Rheostats.
Simplex Elec. Heat. Co., Cambridge, Mass.

Riveting Machines.
Chester B. Albree, Allegheny, Pa.
Bethlehem Fdy. & Mch. Co., So. Bethlehem, Pa.
Cleveland Pneu. Tool Co., Cleveland.
Ingersoll-Rand Co., New York.
Niles-Bement-Pond Co., New York.
Pedrick & Ayer Co., Plainfield, N. J.
William Sellers Co., Inc., Phila.
R. D. Wood & Co., Phila.

Rivet-Making Machinery.
Ajax Mfg. Co., Cleveland.
National Machinery Co., Tiffin, O.

Rock Breakers.
Allis-Chalmers Co., Milwaukee.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., N. Y.

Rolling Lift Bridges.
John P. Cowing, Cleveland.
Scherzer Rolling Lift Bridge Co., Chicago.

Rolling Mill Machinery.
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Morgan Const. Co., Worcester.
Niles-Bement-Pond Co., New York.
Poole Eng. & Mach. Co., Baltimore.
Wellman-Seaver-Morgan Co., Cleveland.
Robt. Wetherill & Co., Chester, Pa.

Roofing.
J. A. & W. Bird & Co., Boston.
Paraffine Paint Co., San Francisco.

Roofing Paints and Varnish.
Paraffine Paint Co., San Francisco.

Roofing Tin.
Am. Sheet & Tin Plate Co., Pittsburg.

Roofing Slate.
J. S. Moyer & Co., Bethlehem, Pa.

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American Mfg. Co., New York.

Rope Transmission.
American Mfg. Co., New York.
H. W. Caldwell & Son Co., Chicago.
C. W. Hunt Co., New York.
Jeffrey Mfg. Co., Columbus.
Link-Belt Eng'g Co., Phila.
Providence Eng'g Wks., Providence.

Rubber Goods.
Boston Belting Co., Boston.
Jenkins Bros., New York.

Sand Mixers and Sifters.
S. Obermayer Co., Cincinnati.

Sash Operating Device.
Amer. Skylight & Iron Wks., Jersey City.
Burnham-Hitchings-Pierson Co., New York.

Saw-Mill Machinery.
Allis-Chalmers Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Fay & Egan Co., Cincinnati.
Jeffrey Mfg. Co., Columbus.

Saws, Hack.
Diamond Saw & Stamping Works, Buffalo.

Scales, Coal.
Richardson Scale Co., New York.

Screens, Mining.
Allis-Chalmers Co., Milwaukee.
Jeffrey Mfg. Co., Columbus.
Mineral Ridge Mfg. Co., Mineral Ridge, O.
Robins Conveying Belt Co., N. Y.
W. S. Tyler Co., Cleveland.

Screens, Rolled Slot.
Allis-Chalmers Co., Milwaukee.
W. S. Tyler Co., Cleveland.

Screw Machines.
Jones & Lamson Mch. Co., Springfield, Vt.
National-Acme Mfg. Co., Cleveland.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

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Chicago House Wrecking Co., Chicago.

Second Hand Machinery.
Chicago House Wrecking Co., Chicago.

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Allis-Chalmers Co., Milwaukee.
American District Steam Co., Lockport, N. Y.
American Tool & Mch. Co., Boston.
Austin Separator Co., Detroit.
John Davis Co., Chicago.
Julian D'Este Co., Boston.
Direct Separator Co., Syracuse.
Goubert Mfg. Co., New York.
Harrison Safety Boiler Wks., Phila.
Hoppes Mfg. Co., Springfield, O.
Potter Separator Co., Newburgh, N.Y.
Warren, Webster & Co., Camden, N.J.
Watson & McDaniel Co., Phila.

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Elec. Controller & Supply Co., Cleveland.

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Cincinnati Shaper Co., Cincinnati.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

Shutters (Fire).
Kinnear Mfg. Co., Columbus.

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Haller Machine Co., Chicago.

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American Skylight & Iron Works, Jersey City.

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J. S. Moyer & Co., Bethlehem, Pa.

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Dayton Elec. Mfg. Co., Dayton, O.

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Allegheny Fdy. Co., Ltd., Warren, Pa.
Globe Mch. & Stamping Co., Cleveland.

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Foster Engineering Co., Newark.

Spike Machines.
National Machinery Co., Tiffin, Ohio.

Spiral Gears.
R. D. Nuttall Co., Pittsburg.

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Am. Steel Foundries, New York.

Stacks.
Cyclopean Co., Brooklyn.
The Petroleum Iron Works Co., Washington, Pa.

Stamps — Steel, Alphabets and Figures.
Schwerdtle Stamp Co., Bridgeport.

Stand Pipes.
The Petroleum Iron Works Co., Washington, Pa.
Struthers-Wells Co., Warren, Pa.
Tippett & Wood, Phillipsburg, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.

Staybolt Iron.
B. M. Jones & Co., Inc., Boston.

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American Steam Gauge & Valve Mfg. Co., Boston.
Ed. Brown & Son, Philadelphia, Pa.
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Star Brass Mfg. Co., Boston.

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Crane Co., Chicago.
Julian D'Este Co., Boston, Mass.
Foster Engineering Co., Newark.
Harrison Safety Boiler Wks., Phila.
Jenkins Bros., New York.
Pittsburg Gage & Supply Co., Pittsburg.
Pittsburgh Valve & Fittings Co., Pittsburgh.
Power Specialty Co., New York.
John Simmons Co., New York.
Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
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Allis-Chalmers Co., Milwaukee.
Bucyrus Co., So. Milwaukee.
C. W. Hunt Co., New York.
Marion Steam Shovel Co., Marion, O.
Mead-Morrison Mfg. Co., Boston.
Robins Conveying Belt Co., New York.

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Albany Steam Trap Co., Albany.
American Blower Co., Detroit.
American District Steam Co., Lockport, N. Y.
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Walworth Mfg. Co., Boston.
Watson & McDaniel Co., Phila.
D. T. Williams Valve Co., Cincinnati.
Wright Mfg. Co., Detroit.

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Walworth Mfg. Co., Boston.

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American Ball Co., Providence.

Steel Concrete Construction.
Berlin Construction Co., Berlin, Conn.
Miller-Collins Co., New York.
Trussed Concrete Steel Co., Detroit.
Tucker & Vinton Cor., New York.
Turner Construction Co., New York.

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Wm. Jessop & Sons, New York.
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Cyclopean Co., Brooklyn.

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Wellman-Seaver-Morgan Co., Cleveland.

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Schwerdtle Stamp Co., Bridgeport.

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Babcock & Wilcox Co., New York.
Model Stoker Co., Dayton, Ohio.
Westinghouse Mch. Co., Pittsburg.

Strainers.
Emerson Steam Pump Co., Alexandria, Va.

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Chester B. Albree, Allegheny, Pa.
Berlin Construction Co., Berlin, Conn.
Browning Eng'g Co., Cleveland.
Interstate Eng'g Co., Cleveland.
Miller-Collins Co., New York.
Riter-Conley Mfg. Co., Pittsburg.
Wm. B. Scaife & Sons Co., Pittsburg.
Tucker & Vinton Corp., New York.
Turner Construction Co., New York.

Sugar-House Machinery.
Am. Tool & Mch. Co., Boston.
Geo. F. Blake Mfg. Co., New York.

For Alphabetical Index to Advertisers see page 11.

Superheaters.
Babcock & Wilcox Co., New York.
F. D. Potter, New York.
Power Specialty Co., New York.
Providence Eng'g Wks., Providence.

Switchboards.
C & C Electric Co., New York.

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Atlantic Works, East Boston, Mass.
East Jersey Pipe Co., New York.
Flint & Walling Mfg. Co., Kendallville, Ind.
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Mecklenburg Iron Wks., Charlotte, N. C.
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Wm. B. Scaife & Sons Co., Pittsburg.
Struthers-Wells Co., Warren, Pa.
Tippett & Wood, Phillipsburg, Pa.
Walsh's Holyoke Steam Boiler Co., Holyoke, Mass.
Robt. Wetherill & Co., Chester, Pa.

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Crane Co., Chicago.
Morse Twist Drill & Mch. Co., New Bedford, Mass.
Standard Tool Co., Cleveland.

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Kolesch & Co., New York.
Lufkin Rule Co., Saginaw, Mich.

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Stromberg-Carlson Tel. Mfg. Co., Rochester.

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Fay & Egan Co., Cincinnati.

Thermit Welding.
Goldschmidt Thermit Co., New York.

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Bristol Co., Waterbury.
Hohmann & Maurer Mfg. Co., Rochester.

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Am. Ry. Supply Co., New York.
Schwerdtle Stamp Co., Bridgeport.

Time Stamps and Recorders, Automatic and Portable,
Perry Time Stamp Co., Chicago.

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Am. Sheet & Tin Plate Co., Pittsburg.

Tipples.
Mineral Ridge Mfg. Co., Mineral Ridge, O.

Tracing Cloth.
Kolesch & Co., New York.

Traveling Link Grates.
Green Engineering Co., Chicago.

Trolleys.
Maris Bros., Philadelphia.

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American Boiler Flue Cleaner Co., Trenton, N. J.

Tumbling Mills.
S. Obermayer Co., Cincinnati.

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Allis-Chalmers Co., Milwaukee.
De La Val Steam Turbine Co., Trenton.
General Electric Co., Schenectady, N. Y.
Kerr Turbine Co., Wellsville, N. Y.
Westinghouse Mch. Co., Pittsburg.
Wheeler Condenser & Engineering Co., New York.

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John Simmons Co., New York.

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Arthur Koppel Co., New York.
Mead-Morrison Mfg. Co., Boston.
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T. R. Almond Mfg. Co., Brooklyn.

Turret Lathes.
American Tool & Mch. Co., Boston.
Jones & Lamson Mch. Co., Springfield, Vt.
Niles-Bement-Pond Co., New York.
Pratt & Whitney Co., Hartford.

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Standard Tool Co., Cleveland.

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G. M. Gest, New York.

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Jefferson Union Co., Lexington, Mass.

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National Machinery Co., Tiffin, Ohio.

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Bristol Co., Waterbury, Conn.
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Alberger Condenser Co., New York.
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Clayton Air-Compress. Wks., N. Y.
Deane Steam Pump Co., New York.
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Guild & Garrison, Brooklyn.
Knowles Steam Pump Wks., N. Y.
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Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
Henry R. Worthington, New York.

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Troy Wagon Works Co., Troy, Ohio.

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W. R. Ostrander & Co., New York.

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John Simmons Co., New York.

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J. A. & W. Bird & Co., Boston.
Hydrex Felt & Eng'g Co., New York.

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Harrison Safety Boiler Wks., Phila.
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Harrison Safety Boiler Wks., Phila.
N. Y. Continental Jewell Filt. Co., New York.
Wm. B. Scaife & Sons Co., Pittsburg.
Warren Webster & Co., Camden, N.J.

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Abner Doble Co., San Francisco.
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Pelton Water Wheel Co., San Francisco.
Platt Iron Works, Dayton, Ohio.
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Woodward Governor Co., Rockford, Ill.

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Allis-Chalmers Co., Milwaukee.
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Deane Steam Pump Co., New York.
Goulds Mfg. Co., Seneca Falls, N. Y.
Holly Mfg. Co., New York.
Knowles Steam Pump Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Lawrence Mch. Co., Lawrence, Mass.
Platt Iron Works, Dayton, Ohio.
Snow Steam Pump Wks., New York.
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Robt. Wetherill & Co., Chester, Pa.
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U. S. Cast Iron Pipe & Fdy. Co., Phila.
R. D. Wood & Co., Phila.

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Clayton Air Compress. Wks., N. Y.
Laidlaw-Dunn-Gordon Co., New York.
Platt Iron Works, Dayton, Ohio.

Well Drilling Machines.
Star Drilling Machine Co., Akron, O.

Well Supplies.
American Diamond Rock Drill Co., New York.
Laidlaw-Dunn-Gordon Co., New York.
John Simmons Co., New York.
Star Drilling Machine Co., Akron, O.
Williams Bros., Ithaca, N. Y.

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Stuebner Iron Wks., Lond Isld. City.

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National Machinery Co., Tiffin, Ohio.

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American District Steam Co., Lockport, N. Y.

Wood-Working Machinery.
Chicago Pneumatic Tool Co., Chicago.
Fay & Egan Co., Cincinnati.
Ingersoll-Rand Co., New York.

Worm Gearing.
R. D. Nuttall Co., Pittsburg.

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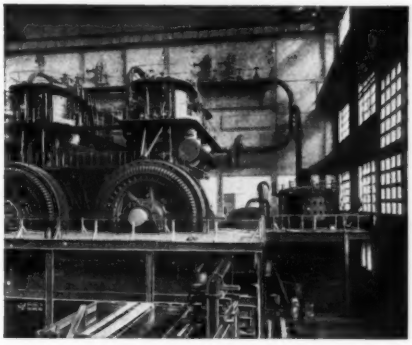
The Ideal Power Plant Unit



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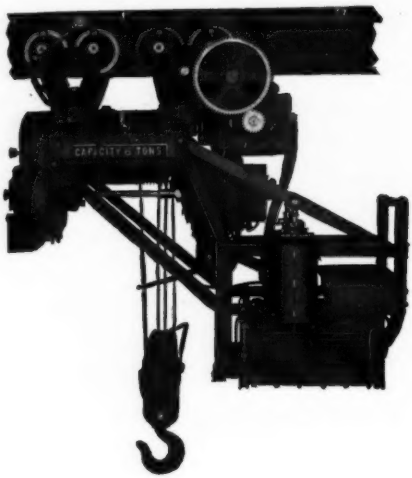

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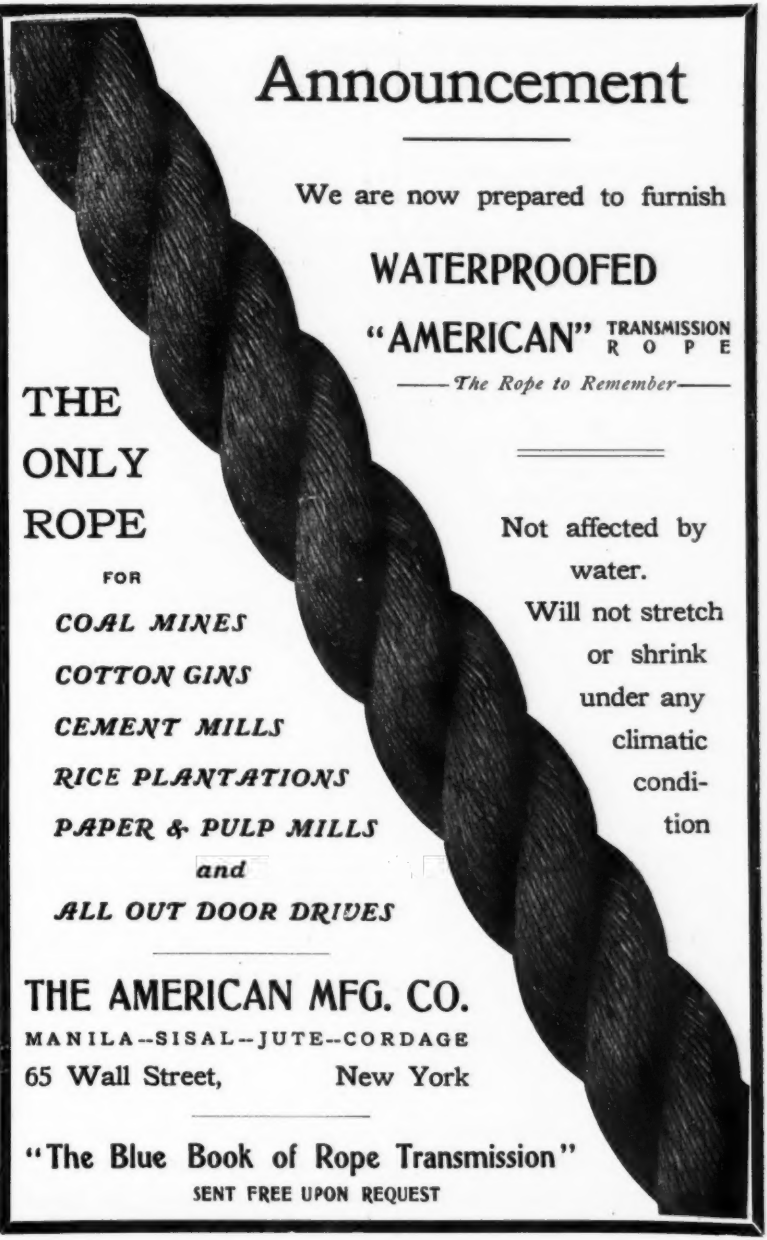
The Rope to Remember



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Not affected by water. Will not stretch or shrink under any climatic condition

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Perfect Shop Management

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A Few Essentials

A positive method of determining the maximum output on every operation by each man or machine, thereby establishing a correct basis of remuneration.

Securing co-operation of workmen and the avoidance of strikes by a merit plan of paying labor.

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The Installation of our methods will secure these results and enable the management to perfect their organization . . . . .

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Many business men have permitted this "walking" method in their establishment so long they have become *blind* to its real wastefulness. When the foreman of a department is needed at the office they either *go* to him or *send* for him to come to them, never giving a thought to the time consumed "coming" or "going," yet it is *time wasted—money wasted.*

Do *you* know what this time is worth—your time or your foreman's? Ever figure out what it costs you every time a business consultation of this kind is necessary on this "walking" plan? Ever figure how many of them are required every day, month or year? How often *heads* of departments "waste" time doing this same thing, "walking" instead of "talking" in the discharge of their duties?

A *mental* calculation alone will convince you this is a mighty costly method. It ought to *influence* you to investigate how much a *Stromberg-Carlson* Intercommunicating Telephone System will *save* you. To do this will cost but *one* cent. A postal request will bring to your desk a copy of our book No. 823, "LISTEN," which handles this momentous question in a most helpful and practical way.

It will tell you in a few minutes what it required us *years to learn* by hard study and actual experience, solving the "time-wasting" problems for hundreds of representative firms in all parts of the country—problems which daily confront manufacturers, merchants, bankers, office managers, hotel men—in fact, *every* business man operating a business with several departments. It will tell you things of especial interest to you because there is not a business of any kind, of any consequence, that we have not equipped with this Twentieth Century business *economizer.* It will tell what is best suited to your needs and why. It will tell you what is best for you to buy and why, and it will tell you how we have been able to build the *largest* independent telephone business in the world, where *everything* from cable to switchboards is made under one roof and of *one quality*—the best. But above all it will *tell you how* to stop the leaks that drain off the *profits* in your business. Is it wise to refuse so much information on so vital a subject when you can get it free? Better send for a copy today, and any information you may want on telephones.

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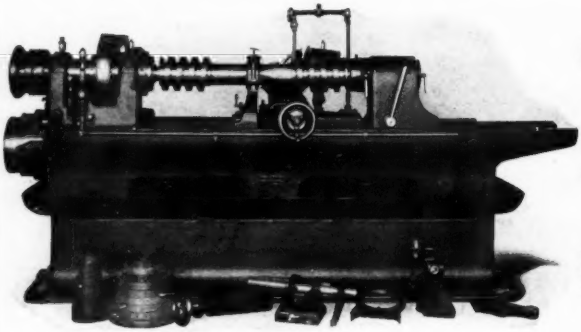
The LATHE CANNOT COMPETE



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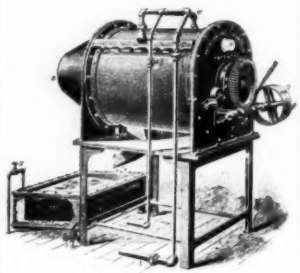

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Especially heavy for coating joints, assembling parts, plumbers' use, etc. Ready for Brush. Does not settle or harden in package.

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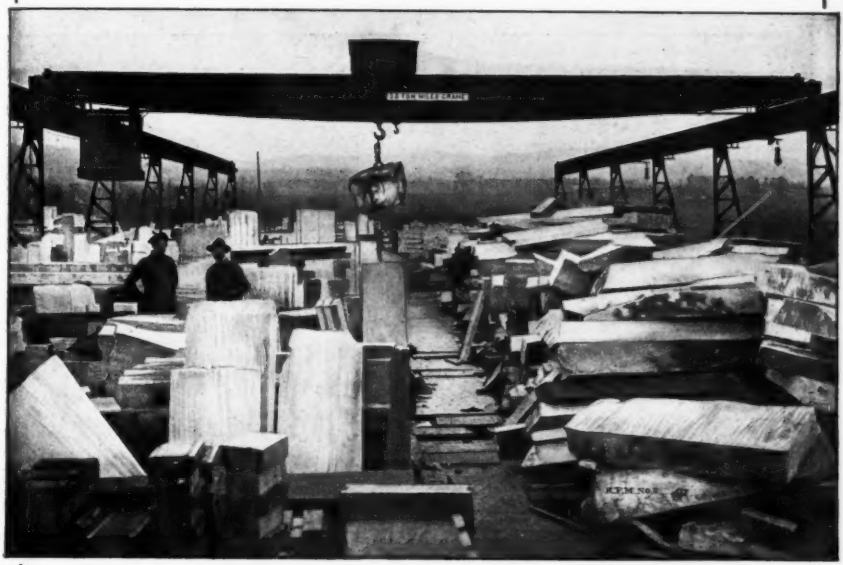
Capacity: 2 to 200 Tons



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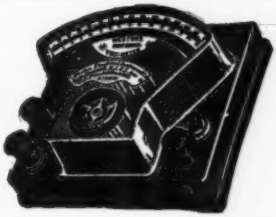

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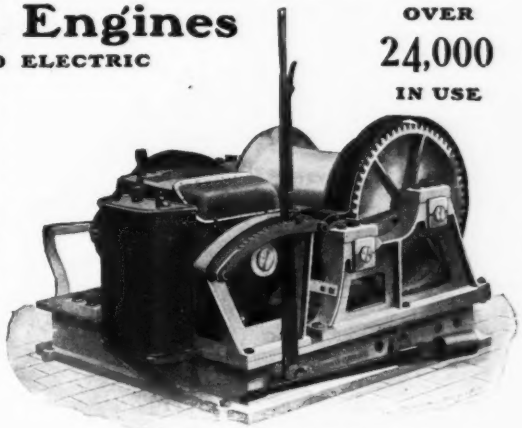

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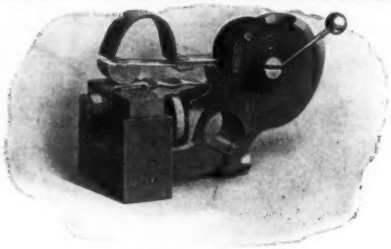
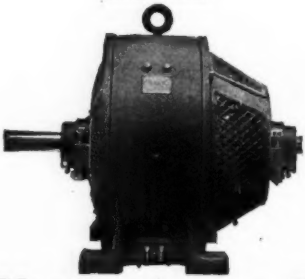


Carbon Holder.



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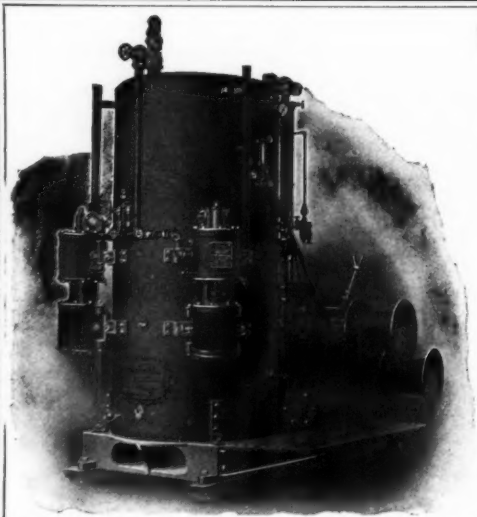

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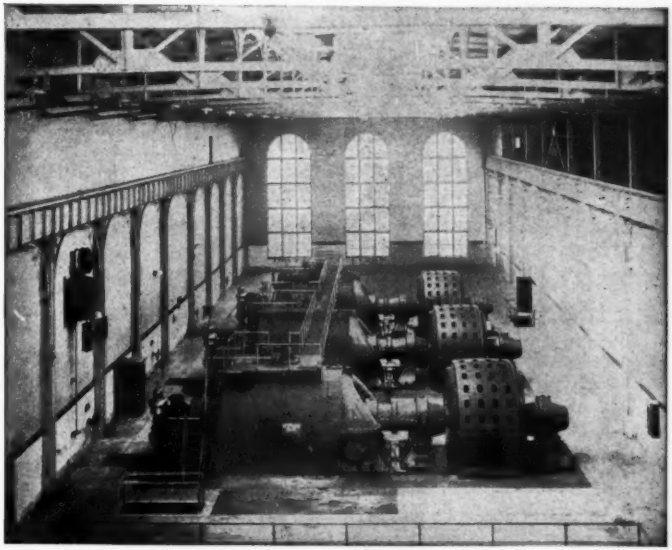

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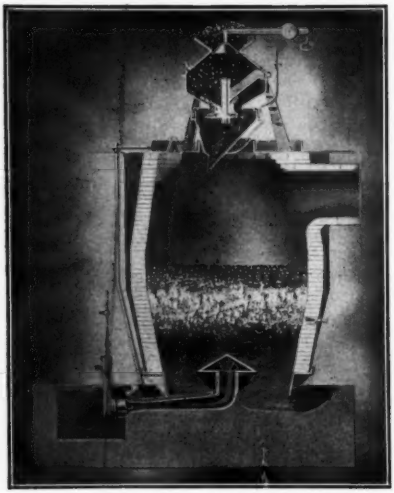

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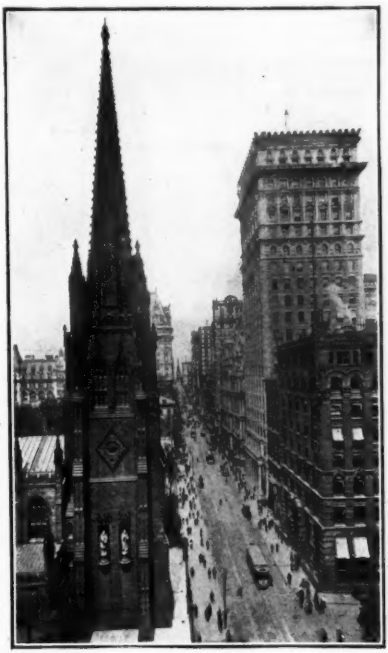

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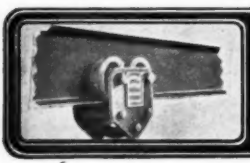

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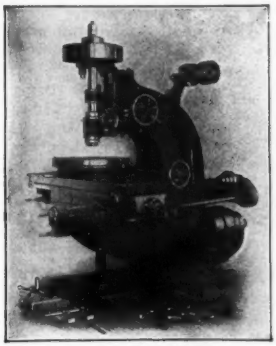

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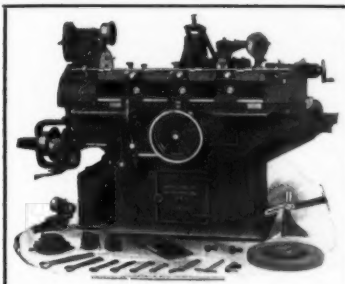

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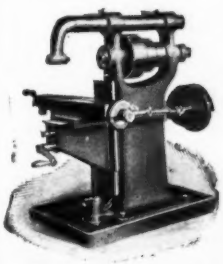

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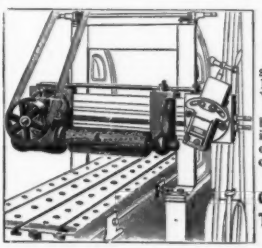

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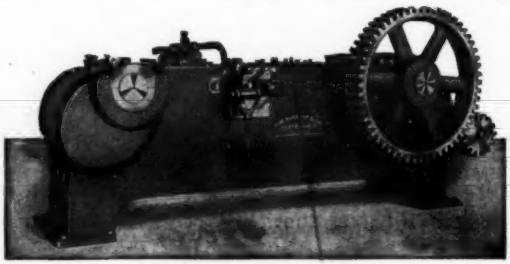

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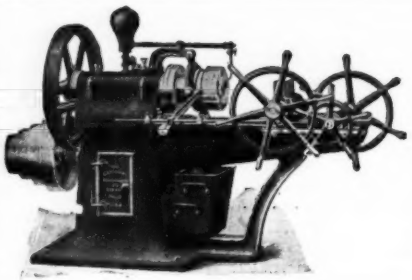

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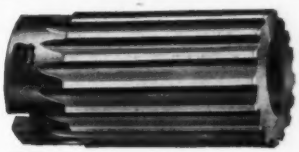

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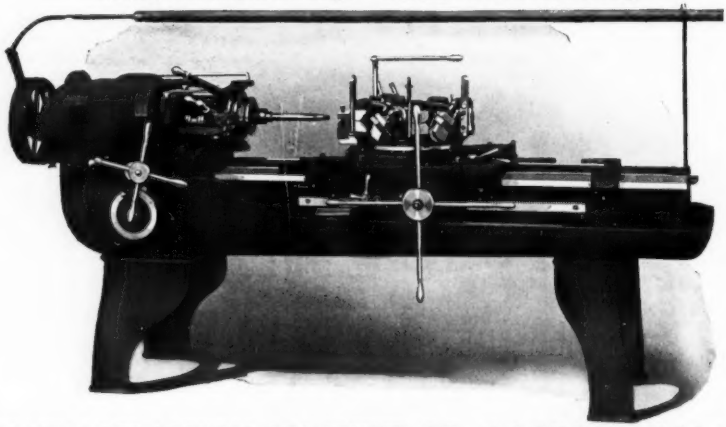

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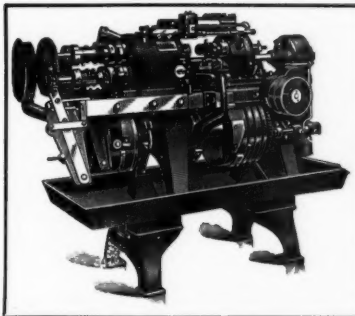

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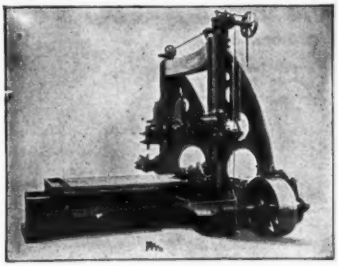

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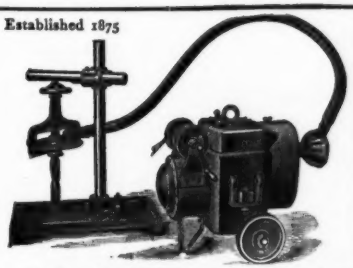

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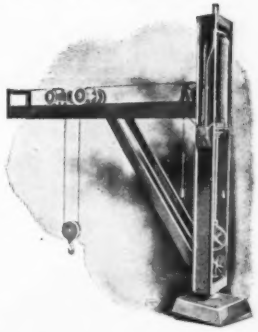

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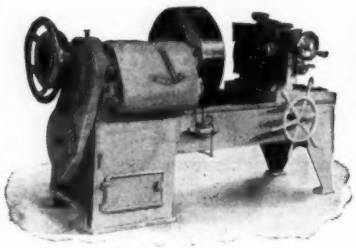

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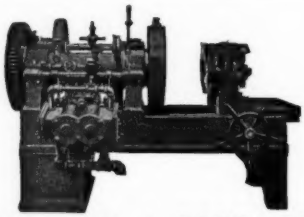

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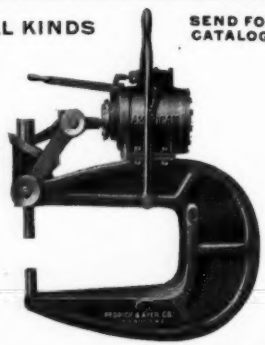

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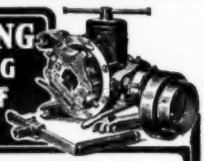

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Fig. 300.—**Front View**

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Fig. 1.

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Fig 300—**Back View**

Fig. 2.—**Internal View**

Fig. 3—**Internal View**

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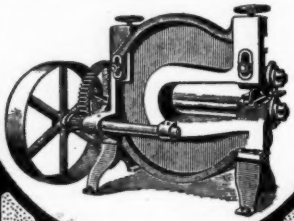

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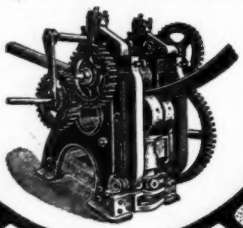

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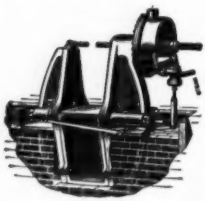

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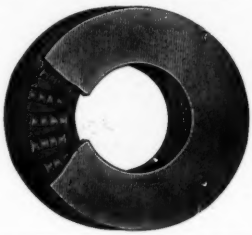

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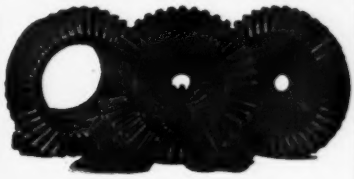

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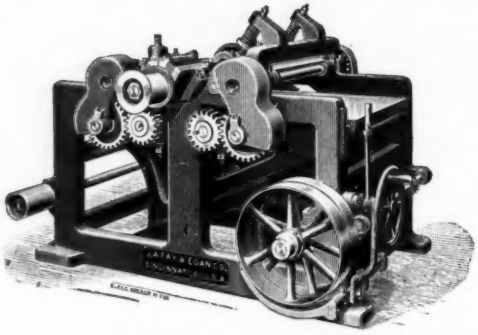

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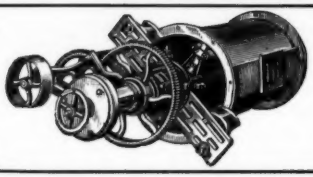

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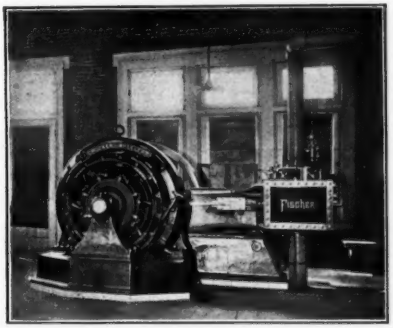

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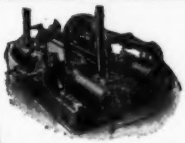

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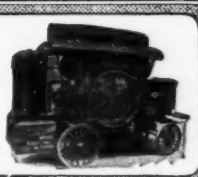

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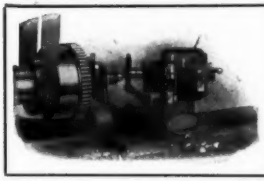

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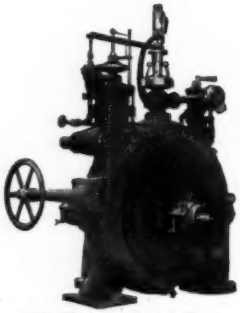

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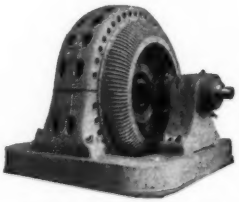

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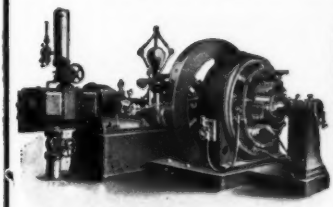

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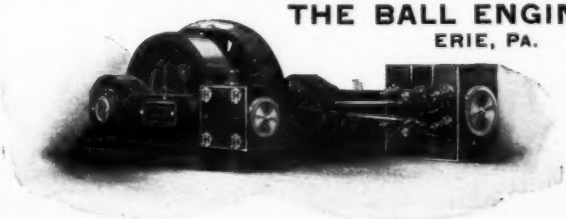

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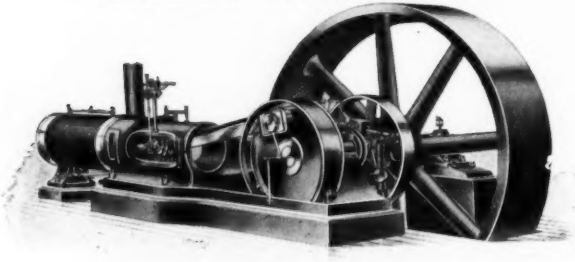

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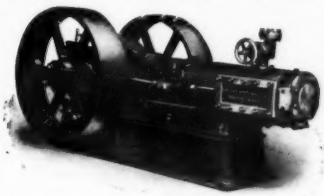

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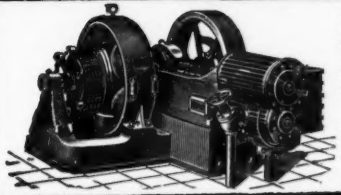

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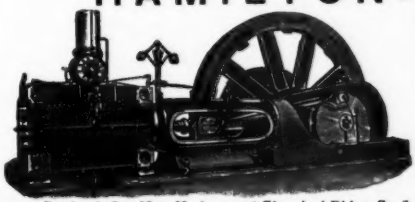

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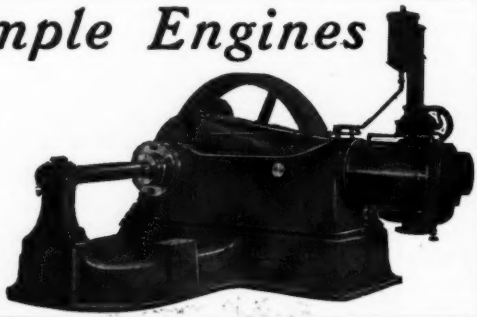

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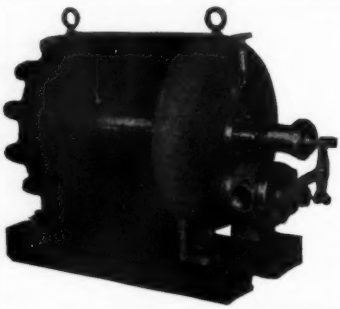

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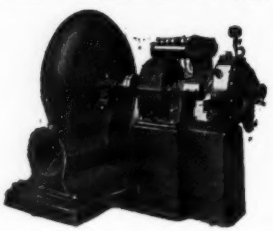

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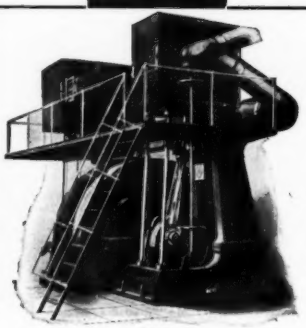

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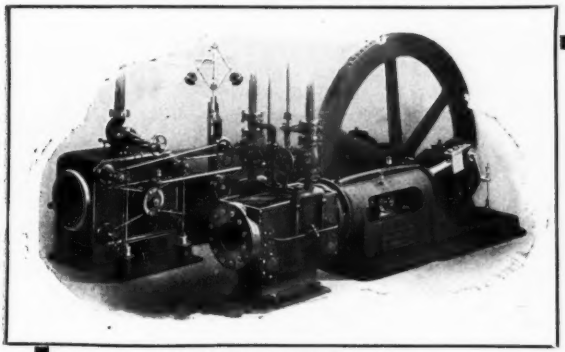

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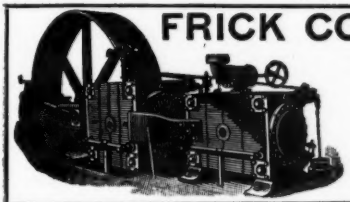

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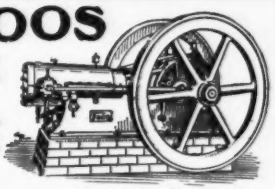

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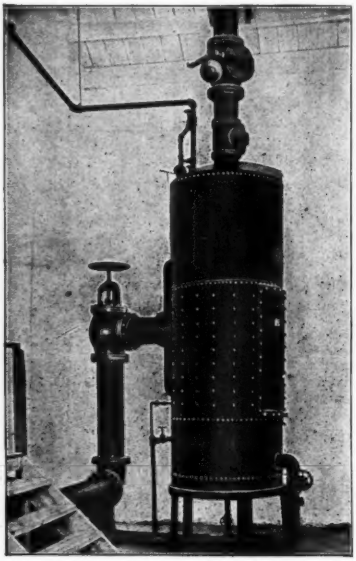

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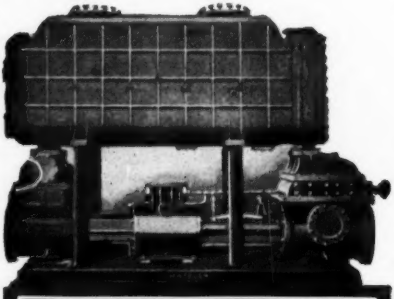

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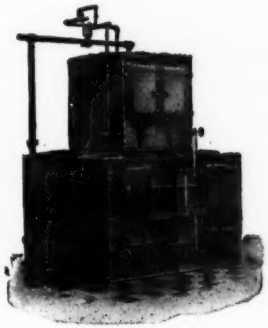

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fuel and repairs will cost you a good deal less than the average; and in bad years, when your competitors only just "come out even," you will earn a good profit.

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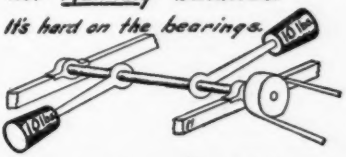

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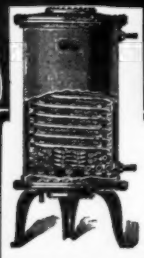

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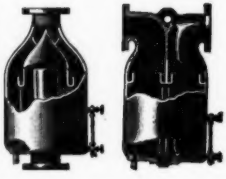

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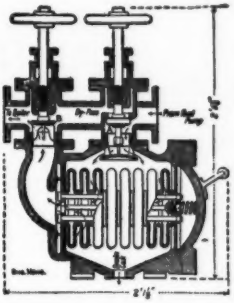

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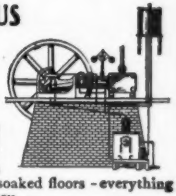

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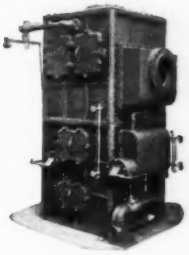

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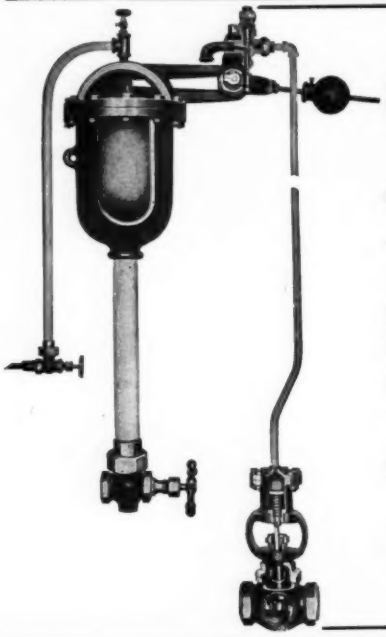

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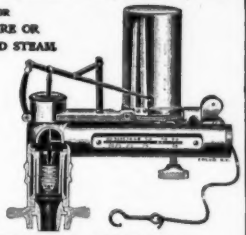

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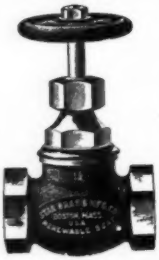

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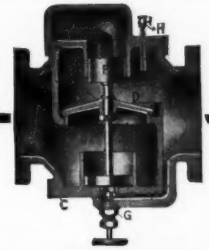

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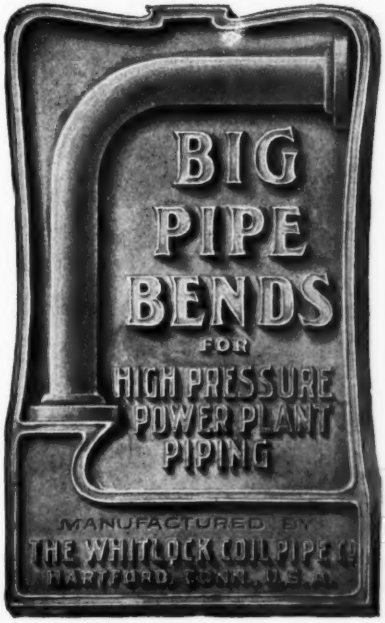

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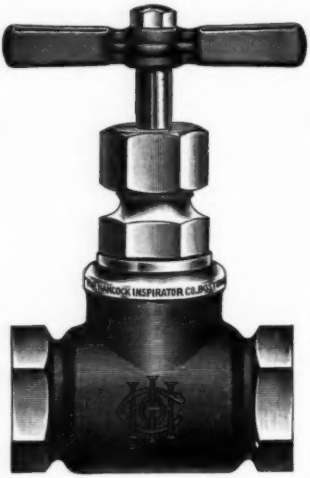

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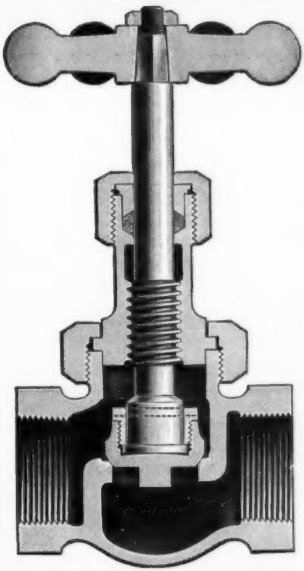

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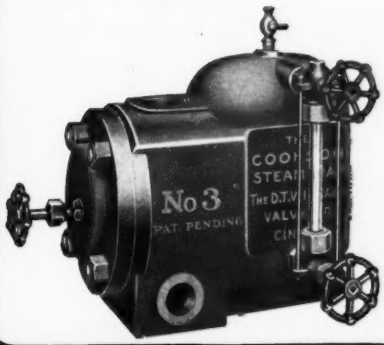

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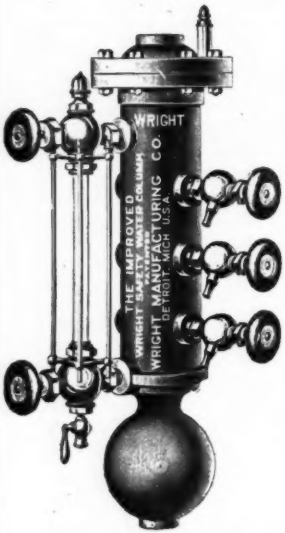

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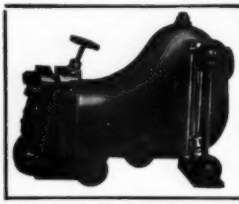

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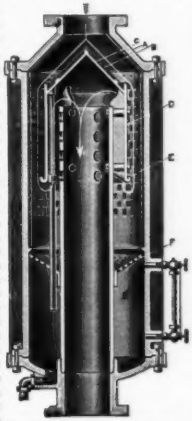

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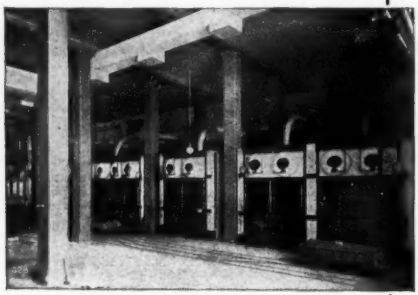
No. 9843

One method of handling coal is to dump the coal from a hopper on to the floor directly in front of the furnace doors, for hand firing, where it remains until it is shoveled into the furnace.



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Charging Cars on an "Industrial" Track is another way to handle the coal from the coal storage to the boiler room. The coal remains in the car until it is fed into the furnace, always ensuring a tidy boiler room floor. The same car can be used to take away the ashes.

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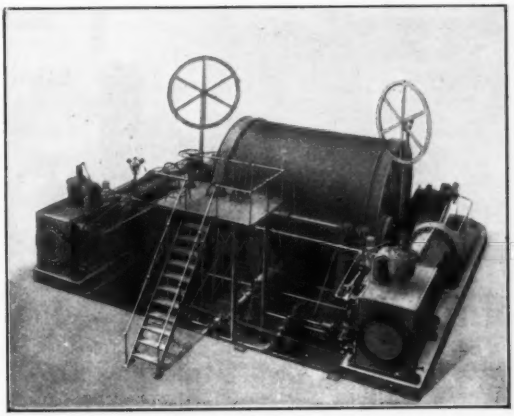

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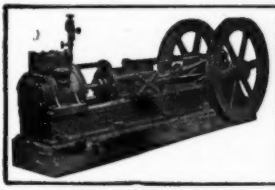

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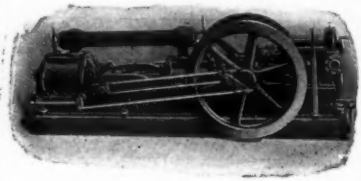

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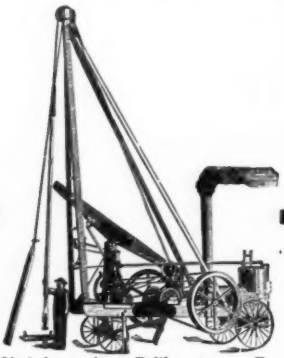

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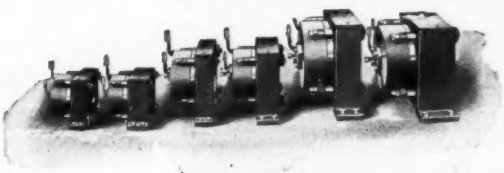

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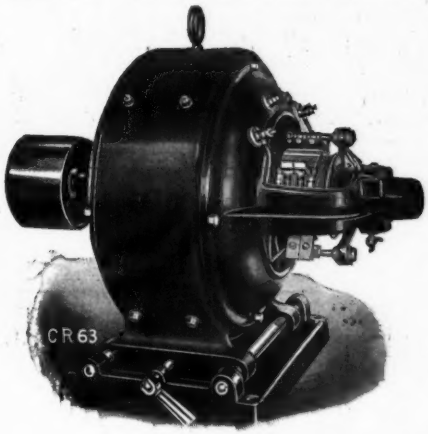

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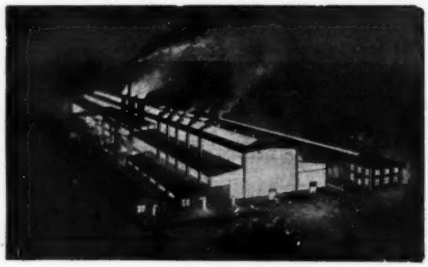
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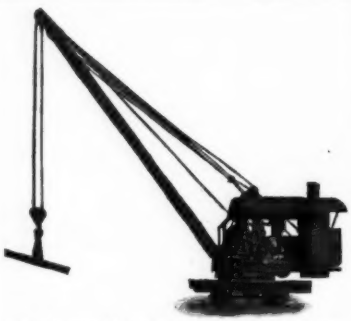

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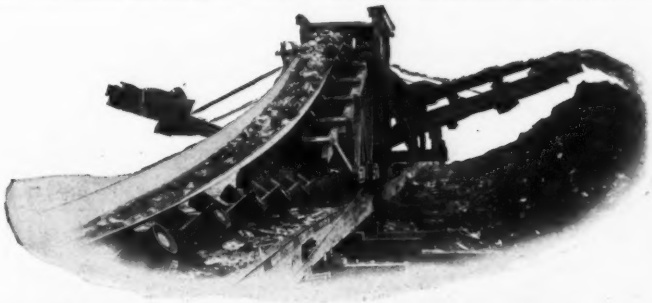

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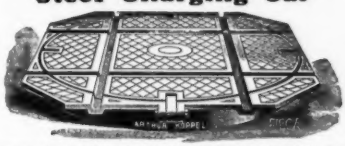
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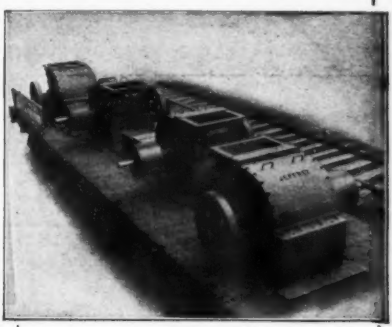
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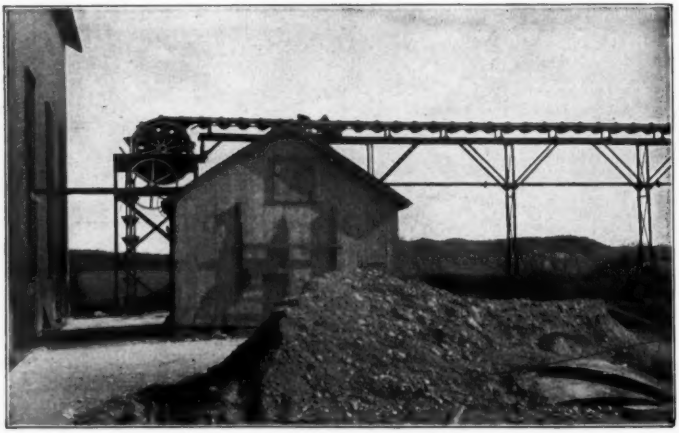

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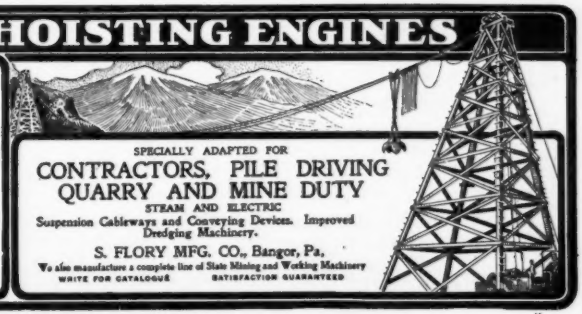

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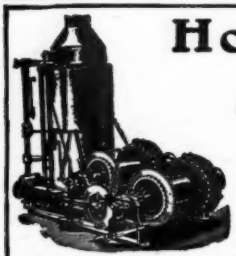

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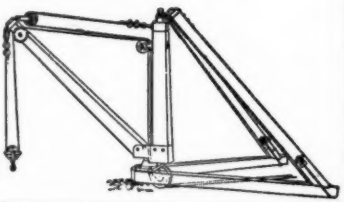

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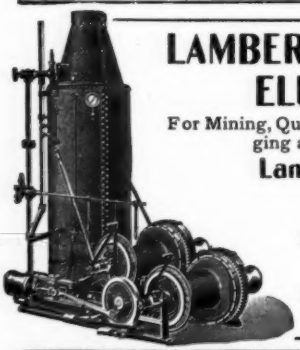

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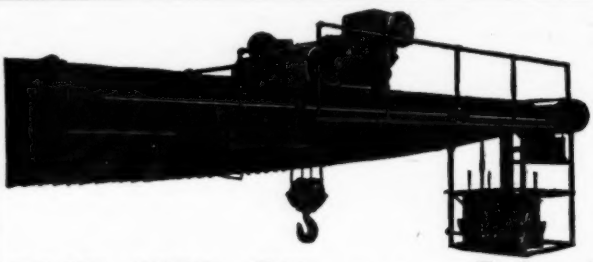

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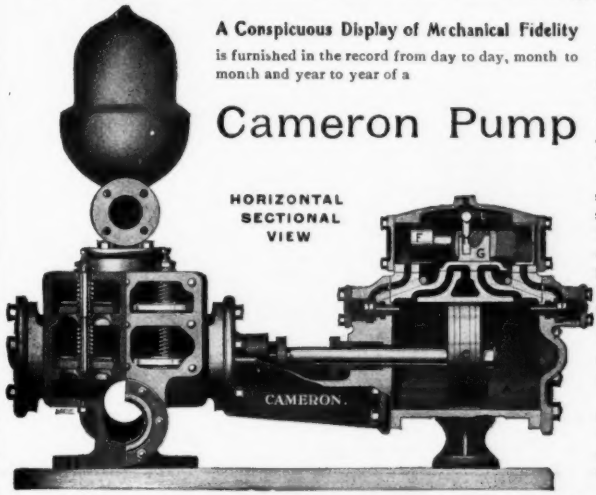

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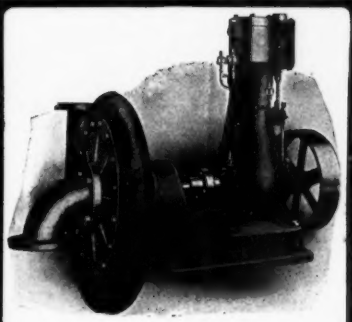

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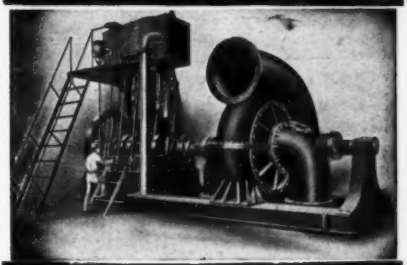

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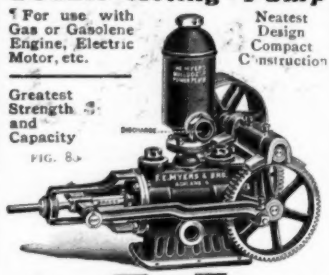

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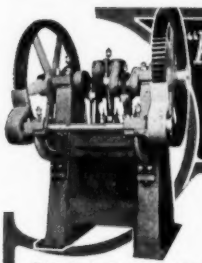

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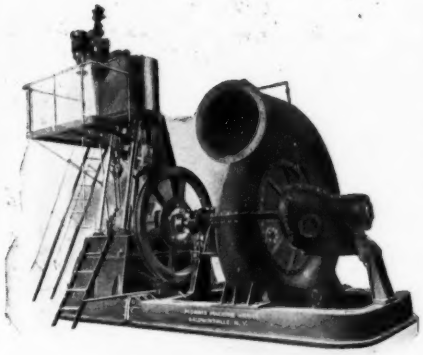

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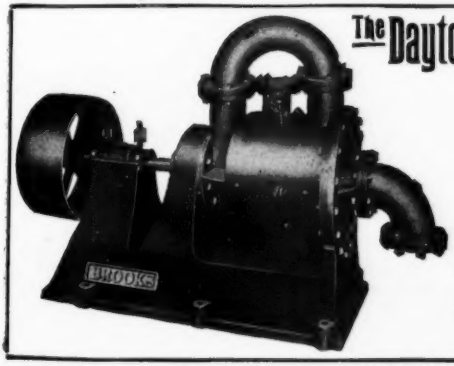

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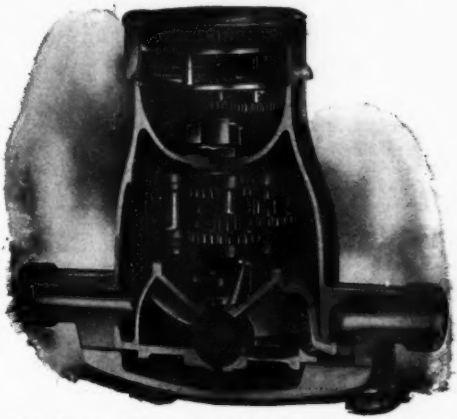

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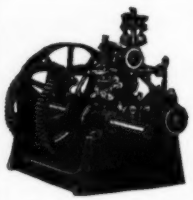

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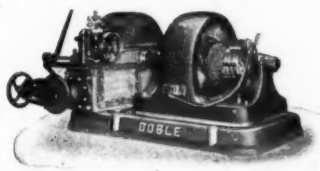

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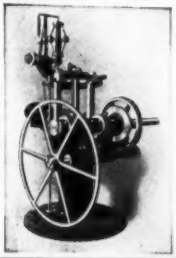

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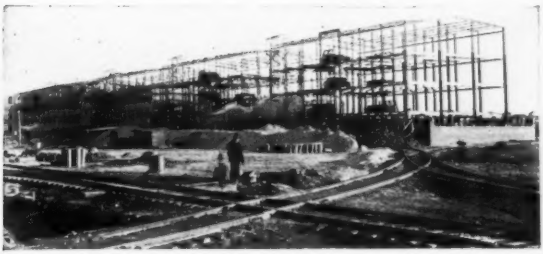

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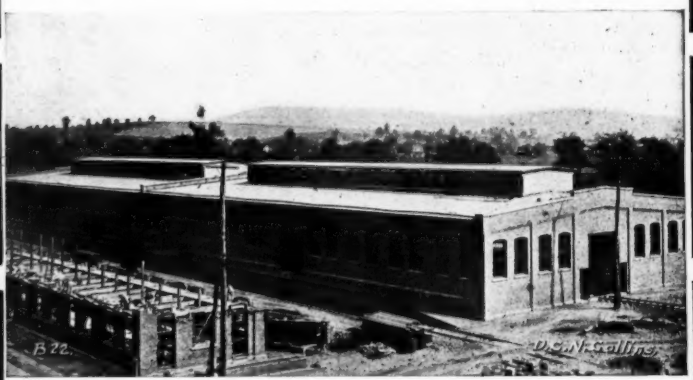

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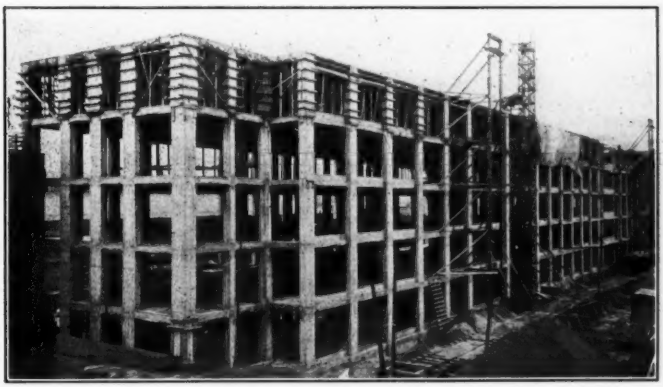

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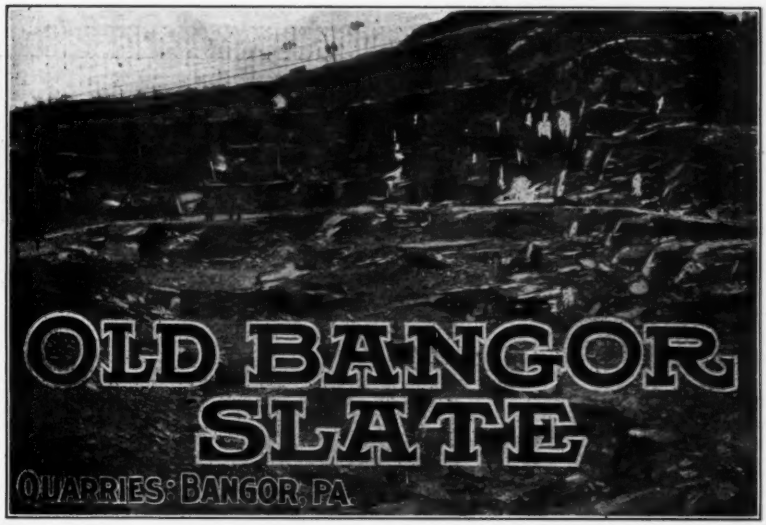

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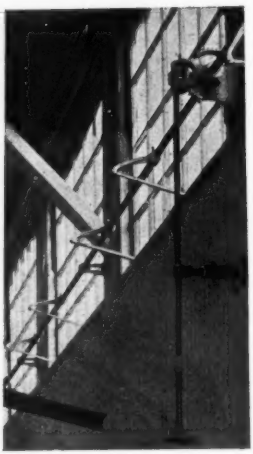

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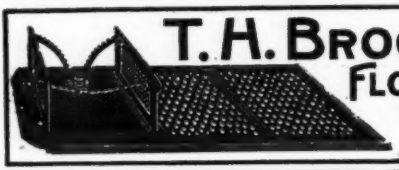

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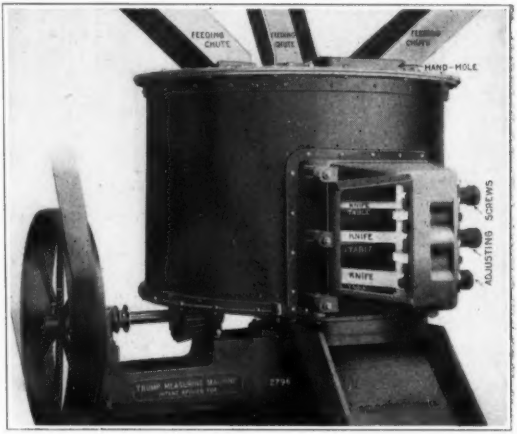

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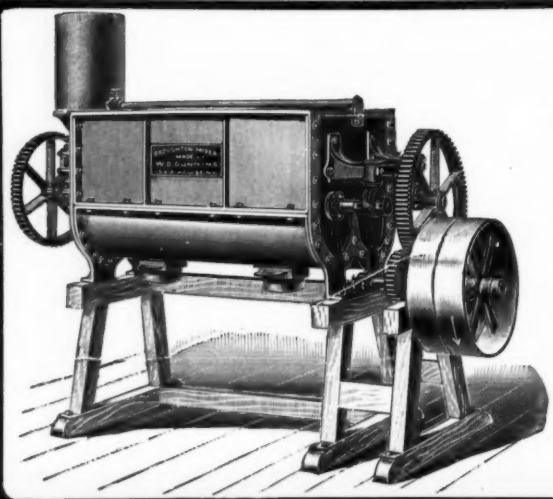

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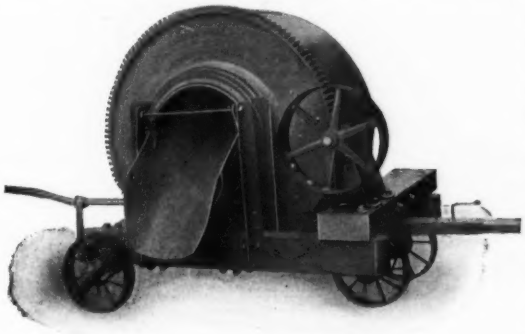

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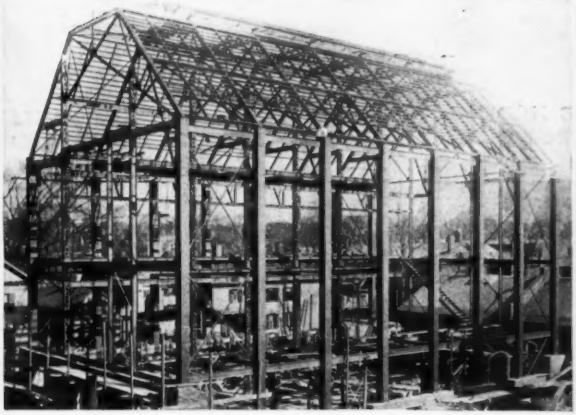

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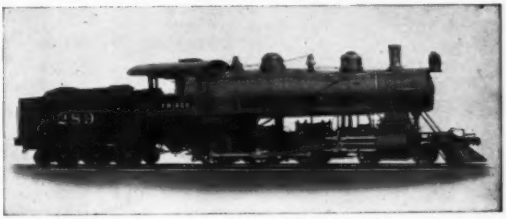

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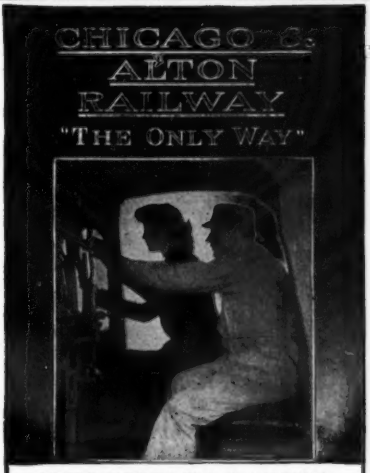

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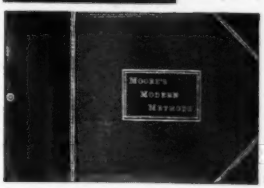

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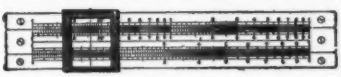

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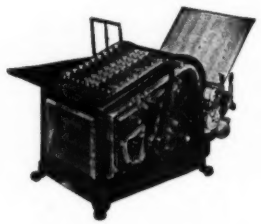

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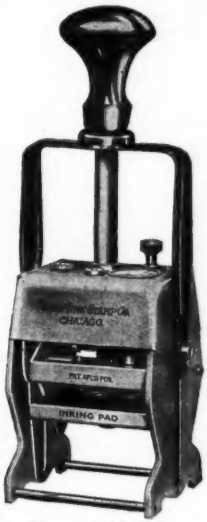

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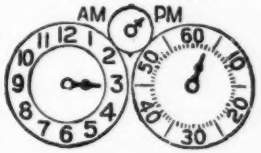

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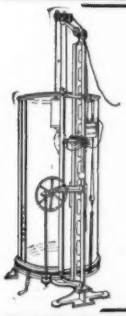

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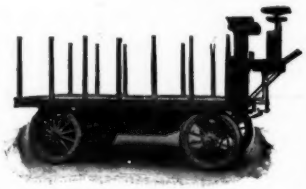

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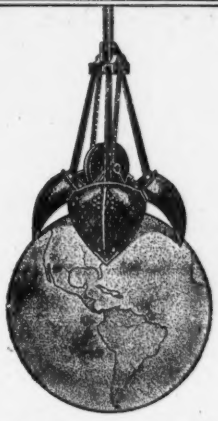

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